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# Journal of the Society of Arts.

FRIDAY, FEBRUARY 9, 1866.

## Announcements by the Council.

### ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 14.—“On the Gas Supply of Paris.” By GEORGE R. BURNELL, Esq., C.E., F.G.S.

FEBRUARY 21.—“On Modern Legislation in regard to the Construction and Equipment of Steam Ships.” By THOMAS GRAY, Esq., H.M.C.S. On this occasion the Right Hon. ROBERT LOWE, M.P., will preside.

### CANTOR LECTURES.

The next lecture of the course, on “Submarine Telegraphy,” by FLEEMING JENKIN, Esq., F.R.S., will be delivered as follows:—

#### LECTURE III.—MONDAY, FEBRUARY 12.

##### LAYING AND REPAIRING CABLES.

1. *Stowage on boardship.* Water-tanks. Cones and rings. 2. *Break.*—Object, simplest form. Appold's break. Dynamometer.

3. *Theory of Submersion.*—Reference to paper by Messrs. Brook and Longridge. (a.) Ship at rest, cable at rest, common catenary (b.) Ship at rest, cable in motion. (c.) Case of spheres dropped at regular intervals from ship in motion. (d.) Motion of an inclined rod in water. (e.) Cable paid out from ship in motion without tension at bottom lies in a straight line from the surface of the water to the bottom. (f.) Tension on cable when laid taut and slack. (g.) Effect of light specific gravity in diminishing tension when cables are laid slack. (h.) Angle of inclination and line of motion of cable through water.

4. *Application of Theory* to common iron or steel covered cables; to the second Atlantic Cable, and to a bare gutta percha core.

5. *Proposed improvements.*—Reels, buoys, floats, nippers, elastic arrangements to compensate for rise and fall of ship.

6. *Repairs in shallow water;* grappling or dredging; under-running; picking up machinery at bows and stern; depths from which cables are commonly recovered.

7. *Repair of deep Sea Cables.*—Proposed methods of recovering second Atlantic Cable; strains on cable when lifted; chance of success.

The lectures commence each evening at Eight o'clock.

### INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Crumlin (near Newport, Mon.), Mutual Improvement Society.

### PARIS UNIVERSAL EXHIBITION OF 1867.

Forms of application for space, and copies of the regulations, may be had on application to the Secretary of the Society of Arts, and should be applied for without delay.

Although the 28th February, 1866, has been fixed as the last day for receiving demands for

space, intending Exhibitors are requested not to delay forwarding such demands, but to send them as soon as possible.

## Proceedings of the Society.

### CANTOR LECTURES.

“ON SUBMARINE TELEGRAPHY.” By FLEEMING JENKIN, Esq., C.E., F.R.S.

#### LECTURE II. MONDAY, FEBRUARY 5.

##### SHALLOW AND DEEP SEA CABLES.

The lecturer first alluded to the omission from the first lecture of any mention of the new insulators—balata, Parkesine, collodion, Mr. Mackintosh's material, and others. This omission was an oversight, due possibly to the fact that, as he has been unable to procure a specimen of any one of these materials for examination, he had formed no opinion as to their merits. The value of a new, good, and cheap insulator would be very great. The following is an abstract of the second lecture, under the heads in the syllabus:—

1. *Serving and Worming.*—Strands of hemp or jute are commonly laid or spun round the insulated core to serve as a pad or protection against pressure from the iron wires afterwards applied, and also, in some cases, to form a larger heart, allowing larger and more wires to be applied than could lie round the small insulated wire. This covering of hemp or jute is called the “serving” of the cable. When several insulated wires, to transmit distinct simultaneous messages, are included in one cable, as for short distances is frequently the case, these insulated wires are laid in a long strand, with hemp between them, to form a circular core. This hemp is called the “worming.” The worming and serving were formerly tarred for their preservation against decay in water, but Mr. Willoughby Smith showed that the tar temporarily mended small faults of insulation, and might, therefore, conceal an accidental injury to the core; but tar was not so good an insulator as permanently to mend the fault, so that the tar might lead to the submersion of a fault which would otherwise have been discovered and repaired before submersion. To avoid this risk tanned hemp is now used, and is often applied wet, to increase the chance of at once detecting any accidental injury to the gutta-percha. Hemp under wires is remarkably durable, and jute also answers well as a cheaper substitute. When hemp is exposed in water it soon decays, and jute decays still more rapidly; both are liable to be eaten by animals where exposed, but not where covered by iron. A specimen was shown where a small quantity of hemp exposed by a kink, at a depth of 800 fathoms in the Mediterranean, had been attacked by a species of teredo; the part immediately adjacent, covered by iron wire, was intact. These animals exist in the Mediterranean even in depths of 1,200 and 1,600 fathoms. In applying the covering, care must be taken that the insulated wire be not overstrained; the simplicity of the work has sometimes led to the use of imperfect machines which might cut the gutta-percha, and to the employment of boys too young to be careful.

2. *Iron Sheathing.*—The served core is commonly protected by iron wires laid round and round in a long helix, and abutting one against another, so as to present the appearance of a simple iron wire rope. This sheathing is frequently called a spiral covering, but the wires lie in a helix, not a spiral, which is a curve like that formed by a watch-spring, not that formed by a corkscrew. There is a popular impression that this form of cable must necessarily be very easily extended or stretched; but this impression is wholly erroneous. The single helix stretches by becoming more nearly a straight line, and by gradually closing so as to include a smaller and smaller

TABLE IV.—STRENGTH AND ELONGATION OF CABLES AND MATERIALS.

## PART I.—CABLES.

*(The Specifications are given at the end of the Abstract of this Lecture.)*

Cables.	Breaking strain in cwts.	Corresponding length in water. Fathoms.	Per cent. of elongation, with one- half break- ing weight, per cent.	Per cent. of elongation, with break- ing weight, per cent.	Weight per knot in air, cwts.	Weight per knot in water, cwts.	Remarks and Authorities.
1st Atlantic .....	80	4,979	0·24	0·8	21·70	16·30	{ Report of Joint Committee, App. 10.
Red Sea .....	65 to 87·5	3,806 to 5,112	0·16 to 0·34	0·56 to 1·16	21	17·30	
Malta, Alexandria ...	147 ,, 157	4,565 ,, 4,874	0·2 ,, 0·36	0·5 ,, 0·86	42·70	32·73	Do. do. do.
2nd Atlantic .....	154	11,000	—	2·57 ,, 4·65	35·75	14·0	{ Unpublished experiments by Mr. Fairbairn. Report of Joint Committee, App. 10.
Steel and Hemp } coated Gibraltar	102·5 ,, 147·5	7,928 ,, 11,407	0·62 ,, 1·24	1·87 ,, 4·06	25·47	13·11	
Iron and Hemp coated	67·5 ,, 75	5,346 ,, 6,000	0·26 ,, 0·77	1·80 ,, 3·10	24·87	12·65	Do. do. do.
Siemens' Copper- covered Cable ... }	50	6,250	—	0·8	18·61	7·97	{ Mr. C. W. Siemens' un- published information. Mr. Allan's unpublished in- formation.
Allan's Cable .....	18·37	7,500	—	1·0	8·0	2·5	
Ratan and Stretched } Hemp .....	15·75	8,500	0·52	1·56	7·73	1·86	Messrs. Forde and Jenkin's unpublished information.

## PART II.—MATERIALS.

Materials.	Breaking strain in cwts.	Corresponding length in water. Fathoms.	Per cent. of elongation with one- half break- ing weight, per cent.	Per cent. of elongation with break- ing weight, per cent.	Weight per knot in air, cwt.	Weight per knot in water, cwt.	Remarks.
Copper strand, Malta- Alex. ....	5·75	—	0·22	8·5	3·57	3·125	{ Report of Joint Committee, Appendix 10.
Core, Malta-Alex. ...	5·75 to 7·5	2,260 to 2,826	0·28	22 to 25	7·15	3·36	
*Iron Wire, 0·079 in.	4·18 ,, 4·5	5,600 ,, 6,040	0·12 to 0·18	0·46 ,, 0·72	96 lbs.	83·5	Do. do. do.
*Steel Wire, 0·079 in.	8·00 ,, 8·60	10,600 ,, 11,200	0·28 ,, 0·34	1·00 ,, 1·80	97 lbs.	84·7	Do. do. do.
Hemp and Iron .....	5·00 ,, 7·43	—	0·16 ,, 0·32	1·04 ,, 2·46	141 lbs.	—	Do. do. do.
Steel and Hemp .....	10·87 ,, 11·75	—	0·37 ,, 0·51	2·28 ,, 2·70	142 lbs.	—	Do. do. do.
Hemp alone .....	2·87	—	—	—	45 lbs.	—	Do. do. do.

\* Other specimens of iron and steel would be found to stretch differently. Some iron and some steel would stretch considerably more, and very hard specimens would stretch less. The above results seem to be taken from fair samples.

cylindrical space: if this closing be prevented, for instance if the wire be wrapped round a solid core, the helix will not stretch more than a solid wire; the closing is prevented in the ordinary cables by the arrangement of the outer wires, which abut, each upon its neighbour, so that a cross section of the cable shows a compact iron ring. The tube formed by the wires cannot diminish in diameter, and consequently the helix cannot stretch more than a solid wire; this is proved by the experiments of Messrs. Gisborne, Forde, and Siemens in the "Report of the Joint Committee on Submarine Cables," 1861. Some extracts from their results are given in Table IV. The stretch of the Atlantic, Red Sea and Malta-Alexandria cables before breaking is, as will be seen, hardly more than the stretch of a single iron wire (part II., Table IV.); the slight excess is owing to a slight diminution in the diameter of the cable due to the more perfect closing of the wires one upon another when the strain is applied. Owing to the perfect iron ring formed by the wires, the inner core is not sensibly compressed. A helix may elongate by untwisting as well as by closing in the manner described, and sometimes this defect has been alleged as the only serious one. The total elongation which could arise from this cause is the difference of length between the wire as it lies round the cable and when stretched out straight. This is about  $1\frac{1}{2}$  per cent. in the Malta-Alexandria cable; but no sensible untwisting ever does occur; about forty or fifty turns are, at most, taken out per mile, and this would elongate such a cable about eighteen inches per mile, or about 0·03 per cent. When cables are recovered

from great depths no sensible change in the lay is found to have taken place. It cannot be seen that they have in any way been untwisted or stretched. Specimens of cable thus recovered were exhibited, and the following experiments shown to enforce the reasoning:—First, half a ton was hung on a light iron cable of the usual form, and it was seen that no stretch occurred, although less than half the weight would have stretched the core inside 20 per cent., and finally have broken it. This proved that the strain was really borne by the rigid helical iron wires outside, not by the core inside. Secondly, weights were hung on a single wire, outside a core of hemp and gutta percha; this stretched a very little. Lastly, an experiment was tried which to all appearance resembled the first, but on the weights being taken off, the rope was bent and opened, and shown to consist of a mere hollow shell of iron wires, without any core whatever inside for eighteen inches of its length. This proved that the iron wires do not press injuriously on the core. In all these experiments the rope was free to untwist, but did not do so sensibly. The experiments were simple illustrations of facts well known to all practically acquainted with telegraphic cables. It may therefore be assumed that the common form of cable is not liable to stretch, but another defect, the liability to kink, has been urged against it. A kink is a loop drawn tight, or a twist in a rope concentrated at one point. Specimens of kinks were shown. A kink may be produced in any form of cable, with or without helical covering, inasmuch as a loop or twist may be produced in any form by mismanagement.

A rope coiled round a drum with one side out may be wound off and rolled round another drum, or paid out into the sea, without receiving any twist, but if, by mismanagement, the rope were pulled off the end of the drum, it would be twisted or kinked. Similarly, if coiled in a tank, with one side always uppermost, although apparently without twist, it would be twisted or kinked when pulled straight out of the hold. In practice these plans are not adopted; the cable is carried down into the tanks from a drum with one side always turned in one direction; let one side of a straight cable be marked black, and let it be coiled into the hold so that the black side shall always be north, then this black mark will, on the north side of the tank, be turned from the centre, at the south side to the centre, at the east and west side it will be uppermost and undermost respectively. The rope thus coiled in will have one twist in it for every turn round the tank; in a spun rope, this twist will twist the rope tighter, or untwist it according to the direction in which the rope is coiled; but in either case when the rope is drawn out of the coil it comes out as it was put in—straight and without twist. The extra turn or twist is caused by coiling, and removed by uncoiling. There is one simple, universal, and sufficient rule to prevent the occurrence of a permanent twist. The cable must be taken out of the tank or off the drum, in the same manner as it is put in or on; the opposite course will always put a permanent twist into a cable, and this twist concentrated at one point, produces a kink. These points were illustrated by elementary experiments with a piece of india-rubber tubing to represent a cable. One side of the tube was painted so that a twist could readily be seen. When a cable is properly coiled in the tank, it is possible, by a severe jerk, so to mis-manage the uncoiling as not to take out the twist regularly, and kinks have thus been caused by several turns being caught up at once out of the hold. This now very seldom happens. Not one kink occurred during the paying out of the Malta-Alexandria, and Persian Gulf cables, or during the late Atlantic expedition, in all about 3,500 knots. Even when a kink does occur, it seldom injures the cable. A specimen was shown, cut from the Dover and Calais cable, containing six insulated wires, through which, kinked as they were, messages had for years been transmitted between England and France. The common form of cables affords a good mechanical protection against injury.

3. *Iron and Steel Wire*.—The tensile strength of a cable is the sum of the strength of the wires composing it. A cable covered with good iron should bear a strain equal to two tons per pound of iron wire per fathom. Thus a cable with 3,750 lbs. of iron per knot, or 3.75 lbs. per fathom, in the sheathing should bear  $7\frac{1}{2}$  tons. This rule corresponds to a strength of about 41 tons per square inch. The larger gauges and inferior qualities of iron cannot be expected to bear so high a strain as this. Best Best is the quality most usually specified, but charcoal wire seems to be more permanent than the inferior brands. The wire should in no case be hard or brittle. Bright wire is generally used for the smaller gauges, and black wire for the larger gauges, unless the wire be galvanised. Table V. gives the relative weights per knot of the different gauges, according to Messrs. Johnson, of Manchester. The weight of a wire per knot in lbs. is nearly equal to the square of the diameter in inches multiplied by 16,100, or say  $16,100 d^2$ . The wires are joined by welding and the cables by splicing. These operations require no special description. Welds should not be allowed in two wires of a cable at the same point, or near the same point.

TABLE V.

SHOWING WEIGHTS OF IRON WIRE OF DIFFERENT GAUGES.

B.W.G.	lbs. per knot.
00 .....	2066.68
0 .....	1716.48

B.W.G.	lbs. per knot.
1 .....	1393.92
2 .....	1212.20
3 .....	1048.32
4 .....	872.80
5 .....	748.80
6 .....	622.08
7 .....	529.92
8 .....	449.28
9 .....	368.64
10 .....	305.82
11 .....	241.99
12 .....	184.32
13 .....	144.00
14 .....	109.44
15 .....	86.40
16 .....	65.66
17 .....	50.68
18 .....	39.16

4. *Sheathing machines*.—These apply the wire with a constant tension, and, so as not to twist it, keeping one side always uppermost, so that if it faces the core below the cable, it will be turned away from the core at the top. To do this each bobbin holding the wire moves parallel to itself. The effect of this arrangement was experimentally shown with the india-rubber tube to represent a wire. The effect of the other arrangement, in which the bobbin moves round the cable fast on a disc, as the arm of a wheel moves round the nave, or as the moon round the earth, was also shown. This arrangement twists the wire. Cables made with twisted wire are weaker and less manageable than those made with untwisted wire.

5. *Permanency of Cables*.—The wires of cables may rust or be chafed through on rocks, or be eaten through by some chemical action other than simple rusting, or they may be broken by anchors. Any motion in the water round a cable much accelerates the rusting away, and chafing depends wholly on this cause. In some bottoms, even in still water or great depths, decay does occur very rapidly, and this must be due to some other cause than simple rusting. Large wires are the natural protection to injury from the causes enumerated. Galvanising also protects the wires from simple rust. In some situations the simple unprotected wires remain wonderfully unaltered, but protection where possible should always be given. Bright and Clark's silicated bituminous compound applied over the wires affords the best protection yet known. The Persian Gulf Cable is coated with it from end to end. To ensure permanency, cables in shallow seas were now laid weighing as much as ten tons per mile with shore ends weighing nearly twenty tons to resist anchors (vide England-Holland Cable, Appendix). Many heavy shore ends were covered with strands of wire instead of simple wires. Mr. Siemens proposed to apply a covering of hemp outside the iron wires and to wrap this round with a zinc armour.

6. *Statistics of Cables in Shallow Seas*.—The total failures of all kinds, in shallow water, excluding cables which had no proper outer iron protection, did not amount to 100 miles. About 2,350 miles have been laid, which worked for some time, but are now abandoned. Of these, 1,400 miles weighed less than one ton per mile, a weight which, for shallow seas, is now known to be absurdly insufficient; these worked for about two years upon an average. 950 miles weighed more than one ton but not more than two tons per mile. The average life of these cables was five years. 5,000 miles are now certainly at work, possibly more; they have already worked upon an average four years and a half; they include one cable which has worked for 15 years, and several 13 years old; but the average is lowered by the long Malta-Alexandria, and Persian Gulf cables, only lately laid. Every one of these cables, except the Malta-Alexandria, not originally designed for shallow seas, weigh more than two tons per mile. The interruptions on the lighter cables are somewhat frequent. On the Malta-Alexandria they have averaged four days per 100 miles

per annum. Even this is not worse than the best land-lines in India, and is ten times better than the worst land-lines in India.

7. *Maintenance and Returns from Cables in Shallow Seas.*—The average cost of maintaining cables of the Submarine and Electric Telegraph Companies has been for some years from £8 to £9 per mile, excluding the cost of total renewals, which should be provided for by a reserve fund. The expense of the Malta-Alexandria repairs is not known. This line has earned as much as £3,000 in one week, or at the rate of £117 per knot per annum. In one year the average earnings during the time it was open were at the rate of more than £90,000, or £68 per knot per annum—allowing for interruptions, the maximum earnings in one year were £64,000, or £48 per knot. The Persian Gulf cable is said to be earning at the rate of more than £100,000 per annum, or £85 per knot per annum. Neither cable has yet worked under favourable conditions; the former ends in a *cul-de-sac*, and the land-lines connected with the latter are so badly worked as to cause extreme delay and uncertainty. Such cables can be laid for sums varying from £300 to £400 per knot. The receipts on the Submarine Company's lines seem lately to have been at the rate of about £85 per knot of cable, or £26 per knot of insulated wire.

8. *Deep-Sea Cables.*—Cables laid in less than 1,000 fathoms would now hardly be considered as deep-sea cables, but formerly a depth of 300 or 400 fathoms was thought sufficient to entitle a cable to be put in this class, and the old classification has been adhered to in preparing the statistics of shallow-sea cables. A cable to be laid in a deep sea must, of course, be strong, both absolutely and relatively to its weight in water; it must be light, or the great lengths required cannot be conveniently carried; it must not be liable to stretch, and it must coil well and be paid out easily. At first, light specimens of the form already described as used for shallow seas were generally employed. The Red Sea cable is a fair sample. The first Atlantic cable is very similar, but the simple outer wires were replaced by strands of still smaller wires. The examination of Table IV. will show how far these cables met the above requirements. They could support from 4,000 fathoms to 5,000 fathoms of themselves hanging vertically from the ship. They could be laid, and about 7,000 miles of this class were laid, in depths approaching

or exceeding 2,000 fathoms, and these cables have even, for a few miles, been hauled back from these depths. They seldom broke while being laid, but they were not permanently successful. Communication generally ended within a year from the time it was established, and the outer covering was then too much rusted to allow of repairs. The causes of failure were many,—bad gutta-percha joints, bad copper joints, injuries to the insulator before the cable was laid, high battery power burning small faults into big ones and eating away the copper, lightning, from which they were often unprotected. These may be instanced as known causes of failure. It is also said some cables were laid too light, and sprung asunder when the iron wires rusted. It may be conjectured that when these wires rusted the gutta-percha could not bear the cable if suspended across a hollow; these are less probable causes of failure, but it is certain that the rusting of the outside and the failure of the cable generally coincided as to time. The failure was seldom gradual; it was almost, if not always, accompanied by a total fracture or interruption in the copper. When any of these injuries did occur, they were irremediable. The first important modification of the common form was to adopt steel wires instead of iron, reducing their number, and enveloping them in hempen strands, so as to produce a cable which externally looks like a hempen rope. Many excellent experiments were made on this form of cable (which was subsequently chosen for the second Atlantic) by Messrs. Gisborne and Forde, aided by Mr. Siemens. These experiments are given in full in Appendix 10 to the "Report of the Joint Committee on the construction of Submarine Cables," published by government in 1861. The great strength, both absolute and relative, of this form may be seen from Table IV., showing that these hemp and steel cables will support 11,000 fathoms of themselves hanging vertically in water. The mass of steel required to cover the core is diminished by the use of hemp, but as hemp is no lighter than water, it does not buoy up the wire. A steel wire simply wrapped up in hemp weighs much the same in water as a bare wire, and therefore wires, whether simply wrapped in hemp or bare, will support equal lengths of themselves in water, but the hemp may be so applied as to add all its strength to that of the steel, although the extensibility of the two materials is different. To do this the hemp must be spun round the steel with a definite lay, to be ascertained in each case by experiment. Table VI. shows th

TABLE VI.

Compiled from App. 10 to the Report of the Joint Committee on Submarine Cables (Gisborne, Forde, and Siemens).

MATERIALS.	BREAKING STRAIN IN CWTs.			ELONGATION IN PER-CENTAGE OF LENGTH.			
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	No. of Experiments.
Steel wire 0·079 in. diameter .....	8·50	8·00	8·20	1·80	1·00	1·41	5
Iron wire 0·079 in. diameter .....	4·50	4·18	4·35	0·72	0·46	·55	7
Steel wire with 4 strands { $\frac{3}{4}$ in. lay of Manilla hemp .....	9·25	9·25	9·25	1·77	1·77	1·77	3
	13·00	12·12	12·59	3·12	2·32	2·63	6
Steel wire with 4 strands { $\frac{3}{4}$ in. lay of Russian hemp .....	10·0	9·50	9·70	2·18	1·80	1·76	3
	11·75	10·87	11·42	2·70	2·28	2·45	5
Iron wire with 4 strands { $\frac{3}{4}$ in. lay of Manilla hemp .....	4·75	4·50	4·62	0·79	·47	0·63	3
	8·50	8·12	8·28	2·80	2·56	2·62	4
Iron wire with 4 strands { $\frac{3}{4}$ in. lay of Russian hemp .....	5·00	4·75	4·87	0·92	0·66	0·82	3
	7·43	5·00	6·2	2·46	1·04	1·82	6
Manilla hemp weighing 0·05 lbs. to } 0·0615 lbs. per fathom .....	3·87	3·62	3·75	..	..	2·62	2
Russian hemp weighing 0·41 lbs. to } 0·45 lbs. per fathom .....	3·50	2·25	2·87	1·60	1·00	1·30	2

strength of iron and steel strands wrapped with Russian and Manila hemp, and with  $\frac{3}{4}$ -lay and  $1\frac{1}{4}$ -lay respectively; also the strength and stretch of the separate materials. It will at once be seen that a difference of lay produces an extraordinary augmentation in the breaking strain and in the elongation. The stretch of a wire when approaching its breaking strain is concentrated nearly at one point, where it rapidly diminishes in diameter. The effect of the hemp is to support the wire at a number of successive weak spots of this kind, and thus greatly to augment the elongation before breaking; but it will further be observed that the breaking strain of the combined materials is actually greater in some cases than the sum of the strengths of the separate materials. Thus the sum of the manilla and steel, taking the mean strength, is a little less than 12 cwt.; but the mean of the combined strand is more than  $12\frac{1}{2}$  cwt. With Russian hemp the sum of the separate strengths is 11.07 cwt., but the combined strand supported 11.42 cwt. The results with iron do not show this anomaly, but the apparent paradox with steel wire has been fully confirmed by independent experiments made for the Atlantic Telegraph Company. The explanation is, that when tested separately we have the strength of the weakest points, or smallest sections of the wires and strands; but these materials are never uniform, and when combined, as it is most improbable that the two weakest points should coincide, we obtain the sum of their mean sections or strengths. The cables formed by these hemp-covered steel wires, are very strong. Table IV. shows that the Atlantic cable, relatively and absolutely, is the strongest cable yet made, bearing more than twice as great a length of itself as the old iron cable. The new form stretches more than the old. The hemp may be eaten off, or decay from the wires, weakening the cable, and the hemp affords less mechanical protection against injury; but the stretch is never such as to endanger the core, as has been proved by repeated experiments, and the most serious defect of the cable is probably its expense.

9. *Proposed forms of Deep Sea Cables.*—Rowett's hempen rope could certainly be laid. The lecturer has had no sample of it, but fears it would be extensible. Allan's cable could also be easily laid, so far as its strength is concerned. It is said to coil badly; but the lecturer has not seen this tested. The proximity of the copper and steel inside the cable might cause the steel to rust and burst the core. Still it is desirable that this form should be practically tested. Mr. Siemens' cable, also mentioned in table IV., will be found described in the appendix to this lecture. The stretched hemp has great strength and elongates little, but has to carry an immense load of copper, which does not add to the strength of the cable. The phosphorized copper sheathing would probably be very permanent. This cable has actually been laid and is now working. A trial of it was not successful in deep water, but a piece was recovered from 1,600 fathoms. Duncan's cable, covered with plaited ratan, is too extensible, and the ratan, though durable in water, does not add much tensile strength. The lecturer has had a sample of cable made, in which he used Siemens' stretched hemp, covered with Duncan's plaited cane. Its properties are given in table IV., and its specification in the appendix. This cable combines great strength, small elongation, lightness, and cheapness. A bare gutta-percha core could be laid easily, but could not be recovered from great depths.

10. *Statistics of Deep-Sea Cables.*—Excluding the 1,000 miles in abeyance under the Atlantic, and the cable lost in the first experimental trips in the Atlantic, only some 500 or 600 miles of cable have been lost during laying. About 9,000 miles have been laid and worked a little while but are no longer working. From 700 to 850 miles are now at work, but much of this is in no great depth. The Barcelona Mahon cable, believed still to work, although faulty, is included in this list. There is but one quite sound cable lying at work in more than 1,000 fathoms, viz., that between Sardinia and Sicily, 243

miles long. One section of the Malta-Alexandria cable is in 420 fathoms, and has never shown any deterioration. The probable causes of failure have already been enumerated.

11. The general conclusions to be drawn from the statistics given in this lecture seem to be, that in shallow seas, by laying heavy strong cables we can ensure, and have obtained, success, both from an engineering and commercial point of view; that in deep seas we have hitherto failed, but that success is not unattainable, and may probably be reached by various methods. The lecturer believes that while in shallow seas, where repairs are possible, cables can hardly be laid too heavy or at too great an expense, in deep seas, where repairs will always be precarious, they can hardly be laid too light or too cheap.

#### APPENDIX I.—SPECIFICATION OF CABLES IN TABLES.

1. First Atlantic:—Core (*vide* Table III. last *Journal*, p. 176), covered with 18 strands of 7 bright best charcoal wires 0.028 in. diameter, called No. 22. Total diameter 0.62 in.; weight of iron, 15.64 cwt. per knot.

2. Red Sea:—Core (*vide* Table III.), covered with 18 bright iron wires (? charcoal), called No. 16, B.W.G., diameter, 0.077. Total diameter, 0.56 in.; weight of iron, 16 cwt. per knot.

3. Malta-Alexandria:—Core (*Vide* Table III.) covered with 18 bright charcoal iron wires, each 0.12 in. diameter, called No. 11 (?). Whole cable, 0.85 in. diameter; Weight of iron, 33.56 per knot.

4. Persian Gulf:—Core (*vide* Table III.), covered with 12 galvanized iron wires, 0.18 in. diameter, called No. 7 $\frac{1}{2}$  (?); diameter of iron cable, 0.9 in.; covered with hemp and bituminous compound to 1.25 in. diameter; weight per knot of completed cable, 3.7 tons.

5. England-Holland main cable:—10 black wires, 0.375 diameter, called No. 00; external diameter 1.56 inch; weight per knot, 10.4 tons; shore end 15 wires, 0.22, called No. 5, covered with 12 strands made of 3 wires of same diameter, covered with Bright and Clark's Composition to 2 $\frac{1}{2}$  inches in diameter; diameter of iron, 2 inches and weight per knot, 19.6 tons.

6. Toulon-Algiers:—Core (*vide* Table III.) covered with 10 steel wires, each enveloped in four strands of Russian hemp; diameter of steel wires, 0.08, called No. 14; diameter of strands about 0.2 in.; weight of hemp in strands (?); diameter of completed cable, 0.8 inch; weight in air, 1.31 tons.

6. Steel and hemp coated Gibraltar (proposed):—Core like Malta-Alexandria, covered with 12 steel wires in 4 hemp strands. Diameter of wires, 0.08; weight of steel per knot, 10.55 cwt.; of hemp 6 cwt.; lay of hempen strands,  $1\frac{1}{4}$  inch; diameter of completed cable, 0.875.

7. Iron and hemp-coated Gibraltar (experimental):—Like No. 6, with iron instead of steel.

8. Second Atlantic Cable:—Core, (*vide* Table III.) covered with 10 bright steel wires each in 5 Manila hemp strands; diameter of each wire, 0.095 inches, called No. 13; diameter of strand, about 0.28 inches; weight of hemp strands per knot, about 12.8 cwt.; lay of hemp strands, 3 inches. Webster and Horsfall's homogeneous steel; diameter of completed cable, 1.125; weight of steel per knot, about 13.75 cwt., and the serving round core about 2.2 cwt.

9. Siemens' copper covered cable:—Sample in Table V. Copper conductor, 550 lbs. per knot; insulator, 420; diameter of core, 0.52 in. Stretched hempen strands, 440 lbs. per knot; copper armour, 675 lbs. per knot; diameter of completed cable, 0.75 in.

10. Allan's cable:—Sample in Table V. Solid copper conductor, 0.114 in., weighing 240 lbs. per knot; surrounded by 19 steel wires, 0.02 in. diameter weighing 120 lbs. per knot; diameter of steel strand, 0.16 in.; covered with 300 lbs. of gutta-percha, diameter 0.456, and canvas web; total diameter, 0.522.

11. Ratan and stretched hemp (sample in Table V.):—

Core, 3·63 cwt. per knot; diameter, 0·34 in.; covered with fifteen hempen strands, weighing 1·84 cwt. per knot; and covered with plaited ratan cane, weighing 1·84 cwt.; total diameter, 0·625 in.

#### TENTH ORDINARY MEETING.

Wednesday, February 7th, 1866; John Hawkshaw, Esq., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Beales, R., Congleton.  
Davis, James, 2, Harley-road, West Brompton, S.W.  
Farnham, Edward, Lordship-road, Stoke Newington, N.  
Gale, James, 5, College-terrace, Belsize-park, N.W.  
Marsh, John, West-bar, Leeds.  
Milnes, Thomas, Zetland-lodge, Southport.  
North, Charles Augustus, 1, Earl's-court-road, Kensington, W.  
Sefton, Earl of, 53, Grosvenor-place, S.W., and Croxteth-park, Liverpool.  
Spong, Rev. James, Mortimer-house, De Beauvoir Town, N.W.  
Swindells, George, Bollington, Macclesfield.  
Taylor, James, 209, Sloane-street, S.W.  
Tanqueray, William Henry, Vine-street, Bloomsbury, W.C.  
Torrens, Captain Alfred, Junior United Service Club, S.W.  
Wace, John Richard, 45, Baker-street, W.  
Ward, Lieut.-Colonel Francis Beckford, Guessens, Welwyn, Herts.

The following candidates were balloted for, and duly elected members of the Society:—

Barry, Francis Tress, The Clock House, Beckenham.  
Bird, Robert, Crewkerne, Somerset.  
Brown, D. J., 34, Great George-street, S.W.  
Coley, Henry, Foxdale Mines, Isle of Man.  
Crossley, Lewis J., Dean Clough Mills, Halifax.  
Davis, Edward Francis, Tavistock House, Tavistock-square, W.C.  
Fox, Chas. Douglas, 8, New-street, Spring-gardens, S.W.  
Frere, Augustus, 22, Henrietta-street, W.C.  
Lewis, John, Kidderminster.  
Mackenzie, Wm., 12, Westbourne-square, Bayswater, W.  
Mason, Rev. Joseph, Loughborough, Leicestershire.  
McCormick, Wm., 22, Cambridge-terrace, Hyde-park, W.  
Medhurst, Thomas, 465, New Oxford-street, W.C.  
Merton, Louis, Junior Carlton Club, S.W.  
Monkhouse, Rev. John, M.A., Church Oakley, Basingstoke.  
Newman, Stephen John, 4, Church-terrace, Lady Well, near Lewisham, S.E.  
Nixon, John, Cardiff.  
North, George, 22, Whitehall-place, S.W.  
Pelly, Charles Raymond, 129, Park-st., Grosvenor-sq., W.  
Smith, George, L.L.D., Trevu, Camborne, Cornwall.  
Spence, Joseph, Holdgate-hill, York.  
Stevenson, John, Baxter-gate, Whitby.  
Stonehouse, Wm., Abbey-terrace, West Cliff, Whitby.  
Trickett, Henry, 67a, Hatfield-street, S.  
Worthington, Richard, 27, Mincing-lane, E.C.  
Yeates, Horatio, 221, Regent-street, W.

The adjourned discussion on the paper read by Mr. William Hawes, on the 29th November, 1865, "On the Proposal that the Railways should be Purchased by the Government," was resumed by

Mr. EDWIN CHADWICK, C.B., who read the following paper, prepared at the request of the meeting just referred to:—There is much in the important subject before us that powerfully affects various arts which the Society promotes, but the question has been brought forward in

the manner more common on political platforms than in scientific assemblies, chiefly by large dogmatic assertions, the answer to one of which involves the exposition of a system. Thus the chief position taken by Mr. Hawes amounts to an assertion of the utter and inherent unfitness of any Government to manage railways, or postal communication, or anything else, so well as is done by private railway companies. The pretensions put forward by himself and other directors of railways go to this—that the formation, maintenance in efficiency, and security of the main lines of internal communication of the nation, are no longer to be of the proper duties and functions of the chief executive or the head of the state; that they are no longer to be, as of old, public highways, the King's highways, or the Queen's highways, but are to be private company's highways, to be private premises, from which the public peace officers may be excluded, and from which every subject is excluded, unless, before he enters them, he stand and deliver whatsoever is exacted from him, not as a payment for a service, but as an exaction of a profit, on his presumed necessities of travelling. The answer to the implied assertions in relation to the primary duties of a Government would be in chapters or volumes of text books, expository of the theory and practice of the proper elementary functions of a well organised state, to one volume of which, as the most profound exposition of principle, I would refer those who would satisfy themselves on the point, namely, the "Constitutional Code for all Nations," by Bentham, in which it will be found that of the several chief ministers, including the Health Minister and the Education minister, whose duties are to be extended, is that of the Interior Communication Minister—the head of a high and comprehensive department of the state, appointed under tests for aptitude, and charged with duties, and subject to real and stringent responsibilities, for maintaining with safety (with the economy, as well as the efficiency, derivable from unity of management), the whole of the interior communications of the country. The pretensions put forward by the private enterprisers in the new method of communication imply further that, whilst the mechanical arts and the experimental sciences are progressive, there is no science or art in legislation or in administration, and can be none equal to those of the commercial companies—that the arts of public legislation and administration are stationary or retrograde, and incapable of any adaptation to changes of circumstance or mechanical or economical progress. If the notion of public administration of Mr. Hawes, and those whom he represents, be that the only possible Government management in this country applicable to the new subject matter in question of railway communication is that of an old department and a decayed system, solely under the so-called responsibility of a changing party political chief, of no more special aptitudes or training for the subject than any retail dealer experienced only in transactions of pence, or perhaps of hundreds of pounds, and the direction of a household or of a shop, usually has for the immediate administration of millions, and discipline of thousands of men as a railway director—if their conception of Government executive management be solely of such a changing political chief who may have to leave the service by the time he had learned it, and whose days and nights are given to a multitude of other and disparate subjects—whose chief concern is less for the success of the branch of administration, than for the success of his political party—if this be the notion derived from too much of our Government as it is, it is a notion that may be corrected by a reference to the great thinker I have cited, and a study of our Government as it may and ought to be. But be the defects of our public administration what they may—and, with other public officers, as administrative reformers, I may claim to have pointed out defects and promoted reforms which outside reformers have failed to see—whilst the pretensions of railway directors to freedom from the



like defects, implied in the claim to have the public functions set aside in favour of the railway administrators—the realities in respect to them are thus stated from close observations by Captain Galton, of the Royal Engineers, who had been long engaged in the examination of railway accidents, and the performance of other duties connected with these companies:—"This vast property is often managed by directors who only meet occasionally, who only give up a portion of their time and thoughts to the concern, and who frequently absorb the time and fetter the responsibility of the manager appointed under them. On one railway, which extends over nearly 1,000 miles, there are thirty-two directors, not one of whom is paid at present sufficient to demand his whole time and thoughts. A private concern could not go on under such arrangements. Besides, those who are officially charged with the duty of looking after the safety of the traffic, do not occupy, as a rule, such a position or status in the company as the importance of their charge calls for; nor is there generally that gradation of responsibility which alone enables the directors to hold their officers responsible for results." Out of 405 cases of so-called "accidents" inquired into by engineer officers of the Board of Trade, only 43, or one out of ten, were reported upon as having arisen apparently from causes beyond control. The great majority were proved to have arisen, not even from the neglect of inferior officers, but from the insufficient regulations, or the want of discipline, or the misplaced parsimony of the directors and superior officers; whose administration is proved, in repeated inquiries, to be at once wasteful and parsimonious from ignorance and incompetence. The late Sir Robert Peel, whose course on railway legislation has been admitted by impartial authorities to have been a deplorable mistake, which has subjected the freedom of trade to the clog of many more millions of extra charges on intercommunication than were imposed by the protective duties on the import of corn, justified himself by declaring his want of confidence in the "torpid hands of government." To whom, however, but to himself, and other party leaders in the like position, was the continuance of this torpidity due, from their neglect to animate the executive hands of government, the permanent officers, with a proper interest in improvement! To the army and the navy the stimulus of prize money is provided as necessary for successful enterprise. Let that stimulus be regularly and specially provided for the civil service, and it will soon be in the van of progress. Yet it will be found that whilst there is this acknowledged defect in our old governmental departments, the private railway management, with a subject-matter more obviously in a state of progress, more urgently in need of improvements in detail—is even more grossly in default in administrative organization in this respect. I might fill whole papers from the expositions of engineers, in the discussions at the Institute of Engineers on railway accidents, with examples, not of speculative, but of tried and proved improvements in methods of administration neglected, and of tried and proved mechanical inventions for security and economy unapplied by the private railway administrators. I may cite such concurrent testimony as the following as to the cause of railway mal-administration, given by Mr. Bridges Adams, who has had experience of the difficulty of obtaining the adoption of tried and proved improvements. In his work on roads and railways, he observes:—"It may seem strange that improvements are not made, but there is little surprising in it. Boards of directors put all the responsibility on their officers, who are by no means overpaid, of making improvements requiring great care in experimenting; and innovations are rarely made in any branch of art by those engaged in the daily pursuit. It is the bystander who looks on and sees defects and invents or contrives remedies which he brings before boards. If the engineer of the line wishes for a quiet life he will content himself with things as they are, and being no worse than his neighbours. If he adopts any improvement and it turns out

a failure, a want of judgment will be attributed to him; if it be a success the inventor gets all the repute from those who cannot reflect that good judgment is as important a quality as good invention, the recogniser as essential to progress as the discoverer. Experiments are denounced as a source of expense, yet it is quite certain that the want of experiments is the foundation of waste."—Pp. 177-8. I must stay, however, to notice the common assumption that slowness to entertain new ideas or to adopt improvement is a habit of our Government solely. Admitting it to belong to such Government as is conceived by the objectors, (such Government, too, as the private and sinister interests tend to produce), I must yet deny that such apathy is peculiar to it. Lord Russell has said that, as a rule, it takes a quarter of a century to get the minds of the British people saturated with a new idea or principle. Look at the struggle of the steam engine during some half a century before it was got into national use. Look at the history of other inventions, and the lives of eminent inventors; why it is a martyrology of long and wearisome delays, of piracies committed upon the labour of inventors, of public loss and individual ruin and misery, arising from the impassibility, the ignorance, or the want of principle, of the common, private, commercial, or manufacturing mind, even to new gains to themselves, individually. Why, in relation to the subject matter, the railway itself was patented in 1733, and there is a yet later example of a railway from Merstham to Wandsworth, passing through Croydon, which was begun as early as 1801 and opened in 1803, when its capabilities were tested by the commercial men and the men of science, who saw that one horse could draw some sixty-five tons at a rate of six miles an hour, and who, nevertheless, declared that railways could never be worked profitably. I knew, personally, Thomas Gray, who first planned a system of general iron railways in 1822, and who endeavoured to rouse the attention of the Corporation of the City of London, with as little effect as the then Prime Minister. I knew, personally, parties concerned in the project for the railway from Liverpool to Manchester, and was told that they took the idea from him, for the purpose of carrying goods; and it appears clearly that but for the accident of a quarrel with the Bridgewater Canal Company, on account of their excessive monopolist exactions, railway communication might even now be in the first stage of its existence. Thomas Gray, whose general system of direct public lines has since been declared to have been sound, died, after a life of conflict, in poverty and neglect, whilst monuments were raised to men who made large fortunes on the basis established by his labours. The apathy which may exist in men of superior position, as to improvements in works or in administration which benefit the public at large, will be found to be often only a faint reflex of that which exists below in relation even to improvements directly benefiting themselves. The low state of administrative ability, prevalent in the private companies, is displayed by the sort of accounts they issue, without logic, without test-points to display progress and to show real conditions, which usually can only be got at by laborious investigation when any question arises. It is singular that in this country, with the largest amount of business, the art of account-keeping should be at the lowest, as displayed by the vast amount of bankruptcy, largely due to ignorance and neglect of duty in account-keeping, against which the French Code de Commerce provides. Mr. Hawes, indeed, who has rendered high public service by his long-continued exertions against the evils of bankruptcy and insolvency, states, in a recent paper on the subject, that the total losses by these evils were proved to have amounted, in 1846, to no less than forty-nine millions of money for that one year. The returns by which it was proved were collected from all parts of the country, and received the most rigid scrutiny, and he said they could be only impugned on the ground of insufficiency. He



only states that this rate of annual loss, approaching to double the interest of the national debt, and exceeding the annual charges of the army and the navy, and all the civil service of the empire, has not since then been increased. Such as it is, I present it him as a study of the superior pretensions of the private enterprisers, as a class, to moral and intellectual superiority, as against governmental administrators, as a class—for the management of such public works as those in question. That the lax habits prevalent in private trade enter, to a dangerous extent, in railway administration, is proved by repeated explosions in large companies, and by the extent of continued occupation of the Courts of Chancery with railway suits. The late Sir John Easthope, who was experienced as a director and in business matters, in French, as well as in English railway companies, told me that he considered that rogues in disposition were as abundant in France as in England; but he attributed the far less amount of defaulting in the French companies to the protection given to property by the far better account-keeping there, which is derived from the French Government, whose accounts, military as well as civil, all English administrators who have consulted them consider to be greatly in advance of any public or private commercial accounts kept in England. A system may, however, be correctly judged of by its outcome. The general promise to original shareholders, by private enterprisers as railway directors, has been 10 per cent. The actual traffic has generally been vastly beyond all previous estimates, yet the return has averaged little more than 3 per cent. to the original shareholders. They would consequently have benefited if they had kept their money in the public funds. Any government which had presented such a failure, such a contrast of performance with promise as has been done by the majority of the railway directors, must have been irretrievably driven from power, amidst general indignation. Whilst such has been the outcome of the management of the boards to the shareholders, the outcome in servants, officers, and leading private enterprisers in public functions, is in frequent princely fortunes, displayed in estates, like those of peers, bespread over the country. Amongst railway directors are no doubt men of first-rate ability and character, and I attribute a great amount of failures to the defective administrative principles on which they act; to incidental and divided attention and responsibility, in place of the constant undivided attention which is needed for the successful management of great concerns. Many of the same men, who give attendance once or twice a week at boards or at committees, would produce results proportioned to their labour, if they were called upon to give all their days and nights to the same subject matters of administration. I myself have tried such posts in concerns in which I took an interest; but, finding that to do justice to them they required constant and undivided attention, I have withdrawn from them, finding indeed that I could, in the like position, only do as others did, and probably, at my best, not so well. Any examination of these defects in the administration of directorates is, however, met by allegations of the defects of the public administration sometimes too true on particular points, and by loud dogmatic assertions of the utter incapacity of the government for the management of the railways. But on this subject we must not allow our observation to be confined, as is our wont, to the experience of this country. Mr. Hawes, in advancing the position that our government, as it exists, is incapable of the responsible exercise of the proper functions of a good government—the maintenance of the freedom, security, and efficiency of internal communication,—that it is incapable of doing what is done by the constitutional government of Belgium, by the constitutional government of Wurtemberg, or by the Swiss Republic, not to speak of what is done by the governments of France, Austria, and Germany, would, if he succeeded, establish the conclusion that ours is a government which, as an obstacle to the most

important progress and freedom of trade, it behoves us to change. For myself, however, I must repudiate his conception of any intention of such direct government management, under existing conditions, as he supposes. When discussing the subject with public officers as a legislative and administrative question, about the time of the completion of the first main lines, some of them will bear me witness that the course I then proposed was that the Government, on inquiry and proper local consultation, such as was given by Captain Drummond and Colonel, now General, Sir John Burgoyne, in their report as commissioners for railways in Ireland, should mark out the main lines of communication, raise money on the public security, and let out those lines to be farmed, and lease them to be worked on contract by the best bidders, as was afterwards done in France and Belgium, where, be it known, the cost of construction, as stated in official returns, was £16,000 per mile, in France £25,000 per mile, against £39,000 per mile in England—with railway fares, for the like quality of carriages, nearly one-third less to the public; with dividends in Belgium of about  $5\frac{1}{2}$  per cent., and in France nearly 7 per cent., as against little more than 3 per cent. to original shareholders in England. Now, one president of the Institute of Civil Engineers—the late Mr. Robert Stephenson, who, it will not be denied, was a man of the widest practical experience in railway matters, abroad as well as at home—in one of his latest public speeches, at a great reception given him in Canada, solemnly warned the Canadians to avoid the example of England, and advised them to look to the examples of Belgium, of Switzerland, and of France. Another president of the same Institute, who had been engaged in the construction of railways in France as well as in England, the late Mr. Joseph Locke, in his inaugural address, declared that the Government of France, “whilst strongly controlling, has also liberally fostered this kind of enterprise, while the English Government, on the contrary, unable to guide, suffered, if not encouraged, hostile or selfish interests to encumber or pervert it.” The French legislature had, he said, “reconciled the two important interests of the promoters and of the state with considerable success; so that while substantial benefits have been secured to the latter, the former have been enabled to derive a liberal return for their outlay.” A third president of the Institute of Engineers, Mr. Bidder, declared, in a discussion on the economy of railways, “that the conclusion at which he had arrived was that the railway system would never prosper until all the lines were worked by contract, and the unseemly quarrels of directors, secretaries, and managers no longer interfered with their success.” Professor Pole and Mr. Jeaffreson, the biographers of Mr. Stephenson, state as his conclusion, in concurrence with others, “that the best authorities on railway interests, and the term includes the interests of the public as well as of the shareholders, are unanimous in avowing the inefficiency of railway management by directorates elected from the shareholders.” The biographers recite, as Mr. Stephenson’s opinion, that the best plan would be to let the railways to farmers, like the farmers of turnpike roads and bridges, who should pay a certain fixed or variable “rent to the shareholders, and retain the surplus rents, that by such a plan the shareholders would be secure of their dividends, and the public of good accommodation. The only individuals who would suffer by the reform are the gentlemen who at present play with money which is not their own.” A fourth president of the institute of Civil Engineers, Mr. McClean, I believe, did present the example of the successful working of the railways by farming, together with a brilliant example of the increased return obtained by low fares. Here, then, as against the opinion and testimony, a very high one, I admit, of Mr. Hawkshaw for the present system, we have preponderant testimony which I have cited; and not only so, but I have a letter from the late chairman of the Lancashire

and Yorkshire line of railway, where Mr. Hawkshaw began his distinguished career, in which the chairman, the late Mr. William Stuart, declares that on this subject France was decidedly in advance of us. In justification of the principle of contract management by the Government, I may cite the fact as of general experience that the postal system of the country was one entirely of Governmental direction, by the contract service of the mail coaches, and that it was so superior to any private enterprise, in security and punctuality, that it was proverbial, that when any one would be certain of arriving at his destination, he would go by the royal mail. The mail packet service, more especially the North British Mail Packet, and the Peninsular and Oriental Packet Service, under Governmental regulations, is, in itself, a greater marvel of the safety of transport, as well as security, than, I believe, will be found under any unregulated private enterprise in transport in the world. That the mails should be conveyed in the Cunard line at the high rates of speed they have been, at night, through the fogs, and the icebergs, and the fishing vessels of Newfoundland, without the loss of a single passenger during twenty-five years; that the Peninsular and Oriental Packet Service should have two hundred and eighty thousand passengers without losing one until recently, when sixteen were lost in a vessel overwhelmed by a cyclone, is a fact in administration as well as in nautical science, which may be claimed as an honour to our time. If, however, the like vessels were provided, officers of the Royal Navy are to be found who would, under a suitable administration, carry out the like regulations directly in behalf of the public. In the latter part of the transport service of convicts to the Australian colonies, under governmental regulations, the health of the convicts during the voyage, as I have elsewhere shown, far exceeded the health of the like classes and ages living on shore under local self-governments of any kind. Public opinion will require governmental regulations to give to passengers, as also to the crews, of vessels under private enterprise, the like security to life, and the exemption from disease, which are obtained in the Royal Navy, where the losses of vessels in service, are now seven times less, and the death and sickness rates two-thirds less than in the scurvy-ravaged ships of private enterprisers of the mercantile marine. In respect to railway conveyance, however, the least irregular are notoriously the night mails, and the distinction is due, as in the case of the mail coaches, to the Governmental regulations, and to such imperfect supervision and correction as the jealousy of the railway directors in parliament permits, but for whom it would be more punctual, more safe and convenient, as well as more regular. The pretensions of railway directions to credit for aiding the new postal system, as well as for competency in their administration, were in great measure disposed of in our report on a parcel postage, printed in the *Journal of the Society* in July, 1858, a great improvement for the retail trade of the country, which is yet obstructed by the false commercial principles on which they were proved to proceed to the injury of their shareholders. I must say that it appears to be a surprising delusion in which a claim is set up on behalf of the railway directorates of serving the post, by an average exaction of 4s. 10d. per mile for the conveyance of mails by railways, as against an average of 2s., for which the service is rendered by mail coaches,—that is to say, as was proved, the monopolist exacts from the public for the use of only a fraction of a train a sum exceeding by 200 per cent. the whole cost of running entire trains. The state of knowledge pervading railway directorates in claiming credit for the success of the penny post is displayed by the fact, that really the highest success of that great measure was, in the old twopenny post or metropolitan district, with which the railways have had nothing to do, and where the increase of

the letters, from one part to another of that district has been sevenfold, and now, mainly from the element of reduced and uniform rate alone, the correspondence within it, upwards of one hundred and seventy millions per annum, equals its correspondence with all the rest of the empire put together. The past railway administration has diminished the benefits derivable from the element of increased speed available from railway communication, and now operates as a serious obstruction, to the improvement of the whole postal system as well as to the general inter-communication of the country. It is established by such testimony as that of Mr. Hawkshaw himself that, with direct lines, properly constructed, and freed from goods traffic,—as already made duplicate lines are,—the general speed of railway conveyance might now average, throughout the trunk lines, the regular rate obtained on some parts of them, or sixty miles an hour. Under unity of governmental management, answers might be obtained in extensive districts, and returned, too, within the same day, instead of the second day. It follows, too, from such facts as those which have been established, that, under a reformed railway system, the London purchaser would be enabled, at half the existing fares, to go to Manchester or to Liverpool, see his goods himself, and make his purchases, do a day's business, and return home the same night, dispensing with the expense, the delays, and the uncertainties of much intermediate unnecessary brokerage and agencies. In respect to the accommodation provided for long journeys, who that has travelled in the first-class saloon carriages in Switzerland, which are improvements on what I am told are the superior saloon carriages of America, will not feel indignant at the relatively barbarous construction, the discomforts, and insecurities of the English railways, which make long journeys by rail, and especially by night, painful and disagreeable necessities which would be postponed on that account alone, apart from the exorbitant charges. The merit and practicability of much of the labour of invention of Mr. Bridges Adams are, I believe, acknowledged by practical men, and his statement will not be impugned wherein he says, "The convenience of humanity should be studied as the datum line for the construction of the carriages. They should be lofty enough to permit standing upright, they should be ten feet in width, with a central passageway to permit the guard to pass from one end of the train to the other, thus getting rid of the difficulty of the want of communication between the guard and the driver. On either side the passage should be enclosed cabins or apartments for four persons each for passengers wishing to be private, and open saloons could be provided for the gregariously disposed. The seats of each passenger should be arranged to fold up against the partition, so that the passenger might sit or stand at pleasure, an important consideration to ensure the free circulation of the blood. Arrangements would be made to provide tea or coffee and similar refreshments whilst travelling, and also for efficient warming, ventilating, and lighting, and, by fitting construction, easy movement, without vibration or oscillation, the traveller would be enabled to read or write at pleasure. In this mode a constant speed of from fifty to sixty miles per hour could be sustained without obliging the traveller to alight or injuring his health by the vibration of the brain or nerves, or the digestive organs by swallowing food in too great a hurry or at too distant intervals of time." Conceive the difference in the amount of inter-communication by families obtainable at long distances by railway reform in these respects, and the certainty of improved returns derivable from reduced fares for proper accommodation! It is a dogma of mine that the fact of a thing being done is cogent evidence of its possibility. The reform projected in respect to conveyance would, I am assured, be the adoption of a reform realised under a governmental management, which private enterprisers on public necessities in England hold cheap. I cite the following description from the *Nord* of the railroad

carriage now running on the Moscow and St. Petersburg line:—"It appears that for the trifling addition of two roubles (about 6s.), to the usual fare travellers are received in brilliantly lighted saloons, around which luxurious sofas and arm-chairs invite the weary to repose, while perusing the latest periodicals, newspapers, or novels which are scattered on the tables. When the hour of retiring arrives the *valet de chambre* conducts the gentlemen passengers to their sleeping apartments, while smart chamber-maids point out to the lady travellers their bedrooms and boudoirs, fitted up, as the advertisement says, 'with every modern luxury, including baths,' &c. The smoking-rooms have perfect contrivances for ventilation and the thorough enjoyment of the cigar, pipe, or hookah." If I were to confine myself to proofs of the governmental success in contract management as a basis for its intervention in behalf of the public, for the reform of the railway administration, I might appear to admit the objections made by private enterprisers, and loudly reiterated, without answer, until they are believed, that the Government is utterly incapable of any direct management of manufactures, or of anything else of an administrative character;—that it does everything badly, and that the glory and success of the country are in its local self-government, in every form. As the question, raised by Mr. Hawes, is one on the art and science of administration, I must beg leave to say something more on the topic, and to deny the proposition, more particularly as the logical conclusion to which the allegations lead, savours somewhat of sedition. And, first, as to the government works. Some years ago, before there had been any important reform of the dockyard management, a noble friend of mine, then a Lord of the Admiralty, got out the expense of a number of ships built at the government dockyards, as compared with the expense of a number of ships built for the Government, at private yards, by private contractors, and it was, proved that, although the contract-built ships were cheaper at the outset, yet when they were tested, after a period of time, they were found to yield no advantage over the Government-built ship. In the Crimean campaign private contract system was a decided failure, and since that time the dockyard management has been improved, by the check given to the political patronage of the borough members, by the competitive examination of the men. In America the Government manufacture is preferred; and in other governments it is proved that, where the quality is important, the private manufacture is the least to be relied on. The attempts made to show that the small arms of equal qualities from private makers in Birmingham have been supplied cheaper, have been, I am assured by competent and impartial investigators, proved to be entire failures, that is to say, as to the comparative cost of working up the raw materials sent in. Mr. Cobden's allegations of the superiority of the private contract system have all broken down. Private enterprisers, Manchester manufacturers—as members of Parliament—have been put on committee after committee, and also on commissions, to suggest improvements in the public administration of service, of ordnance stores, &c., and they have utterly failed in their pretensions;—not that the departments were unsuspceptible of improvement, but that it was proved not to be in the capacity of the objectors to make them. The brother of the writer of the paper, the late Sir Benjamin Hawes, told me that he had shown the methods of conducting business at the War-office to men of private business. But they could offer no amendment, and I may claim to have shown them some large public business, by which they admitted they were surpassed. I shall not be understood as defending all Government management. I concede that Mr. Dickens' characteristics are fairly applicable to much of it. I have myself written largely on the need of reforms in the civil service of the country. It suffices to me to cite instances in proof of a governmental capacity for reforming as well as for being

reformed. Instead of that local self-government, of which the cymbals of self-laudation are loudly beaten by rate-expenders,—instead of it having anything to teach in public administration, the chief branch of it has been itself taught the very elements of business management by Government officers or superior intervention. In the examination of the administration of some sixteen thousand parishes, amidst the penury, the cruelty, the oppression, with the ignorant waste, confessed and notorious on all hands, it was remarkable how rare were the examples of amendment or of capacity of suggestion of amendment which they presented, and scarcely more than half-a-dozen instances of really able administration could be found, and not above three or four who had conceived any leading principle of an improved administration of the parish, one of these being a Captain in the East India Company's service, Mr. (afterwards Sir George) Nicholls; and the other an accomplished clergyman, Mr. Thomas Whately, of Cookham. In large districts the local administrators, even tradesmen and shopkeepers, will have first seen systematised business accounts in the form officially presented to them by government intervention and by governmental officers, by whose labours a saving has been effected of upwards of sixty millions, or two millions per annum; and certainly a better and more beneficent relief administered;—though the improvement, in the application of definite principles, for a more beneficent treatment of the sick, as well as in the training of orphan and destitute children, has been checked midway by the outcry in behalf of local self government and centralisation. The outlay which was charged as an extravagance, for the payment of the Government officers, was about three quarters per cent. on the income superintended, a lower rate than that charged for private professional services. It was about one and three quarters per cent. upon the actual economy effected. In respect to local works, it has been shown by Governmental inquiry and proved by actual work conducted under Government aid and intervention that three houses and three towns may be drained well, or so as to reduce ordinary death rates in crowded districts by one-third, at an expense heretofore incurred by unchecked private enterprises and local government, for draining one ill. Prisons, more especially borough prisons, which were great fever nests, have, under governmental regulations and inspection, been made standards of sanitary improvement, and have an immunity from diseases which scourge honest outsiders. Common lodging houses, under governmental or police supervision, have been drained and cleansed, and preserved from the epidemic visitations which ravage the honest labouring community, whose habitations are under the so-called local self-governments. In the army, the death-rates have been reduced nearly one-half,—with much yet to do,—whilst, despite of precept and demonstration, they are, with lavish expenditure, increasing in the cesspool-tainted districts under "vestralisation" in the metropolis, and under such governments as those of Liverpool and Manchester, and others, where, of all the children born, half are in their graves before their fifth year, chiefly from miasmatic diseases, from which orphan children in district institutions under governmental regulation have an almost entire immunity. In respect to local self government in other respects,—as displayed just now in the almost utter failure of the local police to do what is pronounced to be necessary to check the cattle plague,—it has been shown upon Governmental examination and by normal instances, in conformity with the principles established by inquiry, that but for local ignorance of the principles of public administration, and the existence of sinister interests, the whole country might have had the protection of a general and efficient police for nothing, that is to say, for the money now muddled away by town councils and Watch Committees and parish unpaid constables and Dogberries. Nor is it solely on matters of public though local administration that the general

Government has been in advance in reform. It has carried reform into private manufactories and places which were assumed to be the places where Government interference could only be mischievous. My colleagues of the Commission of Inquiry into the labour of young persons in factories found with myself, that the productive power of these persons besides being worked painfully, was worked wastefully, uneconomically, and uncommercially, as mere stock. The common manufacturing economy was like that of a farmer who raised two colts to obtain one working horse, and that horse by overwork was knocked up in half the period of working ability by premature decrepitude arising from mismanagement. Candid manufacturers, formerly opponents, now admit the sound economy as well as the beneficence of the Government interference, and are advocates for the extension, now going on from trade to trade, of the like interference to check the ignorant and cruel mismanagement of the stock of labour. This brings me to a test point, in my view, of the very core of administration of railways by the common directorates. Mr. James Brunlees, the engineer of the Great Northern Railway, in a paper read at the Institute of Civil Engineers, showed the defective administration of the railway companies, especially as respects the appointment and the management of the great body of men they employ. Intelligence, steadiness, and self-reliance are important qualifications for the economical working of such undertakings, especially where costly and dangerous machinery is to be dealt with. Mr. Brunlees points out that the wages usually given by railway companies are too low to command such qualifications, and, as a consequence, he says, "inferior men are employed, who are incapable of appreciating the importance and necessity of executing their duties with promptitude and exactitude." But this inferior attention is often over-taxed to an extent which would be too great for the attention of men even of a higher grade, and it in itself stamps the character of the common management. He points out the overworking of railway servants as a serious element of danger, principally from the insufficient number employed. "The number of hours," he says, "during which they are kept on duty cannot fail to render them less vigilant. In the course of inquiries it has been found that drivers have, in some cases, been employed for a period of seven-teen hours daily, and they have been known to be on duty as much as 26 hours, and even 30 hours, continuously. An insufficient number of servants tends to unpunctuality, to being obliged to make use of unqualified or inexperienced persons for the performance of onerous duties." Capt. Galton, in a paper in which he showed how small is the proportion of railway accidents which are not directly attributable to the mismanagement of the directorates, also points out that where negligence has been one of the contributing causes of accidents, "the negligence has been attributable to the defective arrangements of the company. For instance, in the case of an accident caused some years ago by an engine-driver running past a danger-signal—the engine-driver and the fireman had been out on the engine for thirty-six consecutive hours. Points-men and engine-men have, in some cases, been regularly kept on duty for seventeen or eighteen hours out of the twenty-four; and sometimes the rule has been, that for one day in each week a pointsman shall remain on duty for twenty-four hours at a time. Negligence in cases of over-work is not chargeable as a fault against the individual servant, but against the company." Instances of the like sort are of constant occurrence. Now my experience, as a commissioner of inquiry into the labour in factories, warrants me in declaring, that twelve, thirteen, fourteen, or fifteen hours of daily attention, from day to day and from year to year, are requirements against the laws of psychology,—against, indeed, the laws of human physiology; that these violations of natural laws involve insecurity and waste as well as cruelty; that the people who commit them, as

these railway directors do throughout the country, prove themselves entirely incompetent to the management of the labour they have in charge, and that they ought, on the score of the labour alone, to be superseded, as decidedly as any commander in the royal navy would be superseded by sentence of a court martial, who, amidst constant dangers, undertook to work his ship by subjecting common seamen to such excessively long watches.—I have now indicated the character of the testimony and of the facts (to which I might add volumes), on which I rely, for the vindication of the governmental capacity, and for the dislodgement of my assailants from the position they have taken up, to justify what is called private enterprise in the public functions. Foreign nations who have followed us in the same course are repenting it. In the United States there are public reclamations for a resumption of the public rights and the state responsibilities in free and cheap communication. At the Social Science Congresses, abroad as well as at home, pretensions like those put forward on the present occasion by railway interests, have been discountenanced, and an extension of the state control insisted upon. I now beg attention to the chief commercial principles comprised in this topic of legislation, by a return to which the great defaults committed may be retrieved. The chief defaults are first, those against unity of management for efficiency as well as economy;—secondly, exactions on necessities, by means of monopolies, instead of payments, merely for service, without profits;—thirdly, charges in disregard of an economical principle of increasing ratios of consumption with diminishing ratios of price by means of monopolies. And first, as to the administrative principle of consolidation and unity of management. Captain Lawes, a very eminent and successful railway manager, estimated the saving derivable from a general amalgamation of all the railways at 25 per cent. That is a topic to be investigated. There are now some hundreds or more of directorates and separate staffs which admit of more or less consideration. But I doubt whether the saving on that head would be considerable, and whatever it might be it would be required for an increase of efficiency by a reduction of the excessively dangerous long daily hours of service, and by augmentations in number and efficiency of the permanent working staff of the railways throughout the country. I imagine that the chief sources of gain to which Captain Lawes must have referred would be those specified by Mr. Braithwaite Poole, an engineer, in a paper read at the Institute of Civil Engineers, in 1856,—on the benefit to be derived from the amalgamation of the whole of the rolling stock in the kingdom, uniformity of manufacture, economy in the use of stock, running trains alternately on parallel lines, or wherever practicable upon one of the two lines only, or, as he points out, "if upon parallel lines, the trains were to run alternately, or wherever practicable upon one of the two lines only, thereby giving better accommodation to the public, increasing the traffic, and diminishing the working expenses." But the gain of time to the public, and accommodation to traffic—and thence on its development to the shareholders—would certainly be considerable. In cross traffic it has been alleged, and I believe it may be proved, that the saving of time by the avoidance of the obstructions from unnecessary changes of carriages and stations, the non-adjustment, often wilful, of the trains of one line to those of another, maintained from mere spite from year to year to the disadvantage of the shareholders as well as of the public, would amount to one-third without any augmentation of the present irregular and often slow rates of speed, as described in the excellent evidence of Mr. Bidder, which I have just seen given before the railway commissioners, who says that two waggons might be made to do the work of three, for if the railways "were worked by individuals, lessees under government, working for their own benefit, it is

well known that they would be worked more advantageously than when railways are worked by boards of directors." "I am certain," he says, "that if the whole of the Irish railways were under one management, traffic would grow up through the country that nobody has any notion at all of." And Mr. Allport, the general manager of the Midland Railway Company, is constrained to admit his failure to obtain by agreement the large benefits derivable from unity. Amalgamations would seem to be favourable to the public interests as well as the interests of shareholders. But from want of capacity for administration, I am assured that those made by the railway directorates are generally illusory in that respect;—that, for the most part, they are merely aggregations of one crudely formed management to another, with continued independent and clashing action, with little or no economy from the more systematised labour and action, derivable from management on a large scale. An experienced railway officer assures me that he can prove that on the London and North-Western alone, by a real amalgamation of lines purchased at enormous cost, from one to one and a half per cent. might be added to the shareholders' dividends. My conclusion in this respect is founded on the declarations of permanent railway officers of their disgust at the incapacity of their directorates. Another source of loss to the public from this disjointed management is one very considerable in every detail of daily business as well as of travelling, which arises from want of uniformity of rates and charges as well as of times. An eminent manufacturer of paper in Lancashire, Mr. Wrigley, tells me that an offer of rags at Plymouth, or elsewhere, frequently turns on the cost of carriage. He can only get immediate information from the railway which passes by his manufactory. The station-master there can only tell him of their own charges, and must write and inquire to ascertain what the charge will be for that particular commodity at other and distant places. It is sometimes as long as a fortnight before he can learn, there being no law or principle which governs those charges. In our report on the subject of a small parcels post, we showed that a parcel to be conveyed from Land's-end to Thurso went by nineteen different modes of conveyance, of which ten were by different railways,—that from Thurso to Valentia in Ireland it must have nineteen different changes of carriers, and fifteen from Land's-end to Valentia, of which the greater part were different railway companies. In travelling, the study of Bradshaw at every journey, and the labour and difficulty of adjustment, occasions a loss of time and worry of money value. Sir Rowland Hill's principle of the uniformity of the penny post, as far as it could be carried—in saving the labour and trouble of adjustment to the public, and of taxation to the officers of the post—was itself an improvement equivalent to a labour saving improvement in mechanics. Such improvement the present management of the railway proves itself clearly incapable of. It has not been able to get uniformity of signals, so important to the safety of property as well as of life. A man who has served on one line has new and most unnecessary changes of system to learn on another. In the railways under the Government control, and with unity of management, the experience gained in one part is freely imparted and collected for the whole, in mechanical as well as administrative improvements. Hence there is a great advance made in the economy as well as safety of construction, beyond ours, in the German States especially. The railways of the country are now much what the postal system would have been if it had been under some hundred separate and independent private joint stock enterprises, conducted as the postage itself was indeed of old, on the railway directors principle, that no one wrote except when he was obliged, and might have exacted from him a charge paid as for a necessity. If a Rowland Hill were to have arisen, under such conditions, with new and available administrative principles, his ability would have been lost in one district. If railway

Rowland Hill were to arise for the reform of railway administration, the first step to make prevalent his principles would be to abrogate these separate managements, and to make clear the ground of obstructions by an entire resumption of the public rights and duties under unity of management. The abandonment of the chief great public highways, as private premises, deprives the public of the protective services of their own responsible police upon them, and obstructs the proper action of that force, at the most important point, or compels an augmented expenditure for other and separate means. It is true that authority is reserved for the public use of railways in the event of war. But the disunity of management impedes the construction of lines, which would be economical for defensive purposes, and in the event of war, the disjointed machine available is of far inferior efficiency and value to what it might have been made without detriment to the ordinary traffic of the country. Disunity, disjointed organization impedes administrative consolidation and prevents the economy which is obtainable by the distribution of rents and establishment charges, obstructs other important public services of daily life besides the conveyance of passengers and goods. I was surprised at the reproach upon the government from Mr. Hawes for not having established a postal telegraph; and I trust he will join in reclamations for wiping that reproach away. But does he not see, that in giving up the main lines of communication of the railways to private and irresponsible persons, impediments are placed in the way of the most eligible lines for the economical use of that great invention? Does he not perceive that the very principles he advocates in respect to the giving up railway communication to private companies are applicable to telegraphic communication? This disunity and disorganization subjects the public to the labour of verification, to the worry and loss of time in intercommunication, which in the every day business of life is in the aggregate a serious discomfort, a drain upon the nervous energy and temper, positively detrimental to health. This is experienced particularly in such wretched places as the Clapham Junction, or other metropolitan railway junctions. Under the present disorganised practice there is a serious loss of time in seeking and going from one establishment to another. Thus, in the British metropolis, if you want to send a letter by post, you must go to one establishment; if you want to dispatch a telegraphic message, you must seek out or send to another, and commonly a distant one; and sometimes you are troubled to enquire, and decide between two competing lines. If you want to forward a small parcel you have to send your servant to hunt, and enquire, and decide between several offices. But if you are in Switzerland, at Zurich, you go to the one office and deliver your letter or send your telegram, which goes at one uniform franc rate all over the country. At the same establishment you send your small parcel, whether it be a book or anything else, at a certain uniform charge for delivery. When, a short time ago, I was in Switzerland, and made some inquiries as a matter of administrative interest, as to the application of the postal system to the telegraph and small parcel post, my inquiries were met by expressions of surprise that there should be any doubt on a matter so simple, and that the English, who were so clever and advanced in some directions, should be so absurdly stupid and backward in others, and should allow ourselves to be hoodwinked into pernicious protectionism of parcels, and irresponsible monopolies at the expense of the public in money, in safety, and in comfort. The answer to the reproach generally made by the private enterprisers on public functions, that foreigners allowed their government to do everything for them, was, "We make our government officials return full and due service for the taxes we pay and the position we give them. We do not consider that the functions of our government are merely to make perfunctory laws, to tax and to punish. We are not such fools as you English to pay twice—to pay one

set of men, who ought to be our responsible servants, and then to pay another set of men, who are not responsible, for doing their duty in disagreeable manners and at such extravagant prices as they choose to exact." Involved in the waste attendant on disunity of management is the practice of competition by duplicate and triplicate lines. It will be alleged that the principles I advocate are opposed to competition, to which it is said we owe our great commercial advances. On the contrary, it will be found that the administrative principle originally propounded here and afterwards adopted on the Continent, gives an opening for competition on the largest scale and of the most efficient description on an economical principle, which I have illustrated at length in a paper which will be found in the transactions of the Statistical Society, and which I believe most economists now recognise as sound, the principle of what I call "competition within the field," meaning for the whole field of service as against competition "within the field ending in divisions of parts of it." I have there shown that to commit two or more capitals into a competition for a service which can be accomplished by one is always a waste, generally at the public expense. Like races between heavily-weighted horses, such competitions between concerns heavily weighted by separate establishment charges must result in comparatively reduced speeds, that is to say reduced profits. I would ask where the utmost competition between duplicate lines in the same field has left us, but in fares more than one-third behind Belgium, with a disjointed, jarring, conflicting system, and far inferior means and chances in the present state of things, of future progress, and the shareholders with reduced dividends. The original foundation on which commercial men proposed railways, and on which new capital is yet continually obtained, is false in economical principle as applied to such subjects, and is in itself a proof of their incompetency to deal with it.—The next economical principle to which I have at present to advert, which I have elsewhere endeavoured to expound, is that of exactions under monopolies on necessities instead of payments for services. There is a large organic distinction between charges which have relation solely to the services rendered, and payments which are founded not on the consideration of these services by the agent, but on the view and estimate of the necessities, and on the power of exaction under monopolies on the person's means of payment and necessities of travel. I illustrate the distinction in principle by such examples as the following, which are familiar at our seaports. A belated traveller from London presents himself, say to a group of Deal boatmen, to be put on board a vessel just out of hail and about to set sail. The boatmen see, that unless "the fare" is put on board, he will lose his voyage, and probably his passage money; and instances occur where not one boat was to be had for less than five pounds or more to put the passenger on board, to do that for which the payment of half-an-hour or an hour's work in a regulated service, the payment, in fact, of as many shillings would be most liberal; whereas the payment enforced is an exaction on necessities. The whole of the Company's system of charges for the carriage of goods, not on account of any special care required, or risk in the way of insurance charges, but on account of their supposed value, or the necessity of their conveyance—charging for iron on some lines more than four times more than for coals; charging coals not for their carriage but for their quality. The progress of the productive powers of the country will be found to require that this pernicious principle of exactions on necessities should be abrogated, and the administration of the public means of communication placed in disinterested hands. For it gives to producers or distributors of one class, acting as directors, the power of wielding the means of communication for the promotion of their own trading interests, at the expense of rivals; it gives to the manufacturers of one district the power of speeding in

cheapness their own produce at the expense of manufacturers and traders in others—paying for the transport of their own produce at low rates by excessive charges on passengers. By the irresponsible exercise of the powers conferred by this pernicious principle of action, they may change the distribution of the manufactures of the country, as they are charged with having, in relation to one commodity, gone far to do. It was the vicious principle of the old postal system, that no one wrote a letter unless he was obliged, and, consequently, that you might tax him as you pleased, and that any reduction of the tax would be a loss. The like assumption prevails as respects passengers amongst trading railway administrators—that no one travels unless he is obliged, and that, consequently, any reductions of fares, or any extra expense for comforts or improvements, in convenience, is simply so much revenue lost. I have little time to do more than mention the third main economical law, commonly contravened by private trading railway administrations; that of increasing ratios of consumption with diminishing ratios of prices. It is what I have called a law, that if in any given community there are (say) a thousand purchasers of an article, or payers for a service at a shilling, there will be in that same community not merely two thousand, but three or four thousand, purchasers at sixpence, and at three pence, not merely eight thousand, but twelve or more. Of course to that law there will be wide variations, which may only be determinable by very extensive observation, or by actual practice. To the operation of that law, as I conceive, we owe the rebounds of our revenue from successive reductions. To it we owe the astonishing replacement of the postal revenue, under the large reductions of the penny post. To it, I conceive, we must look for the retrieval of the country from the disadvantageous position in which by false principles of economy and legislation it has been placed, in relation to the trade of other countries, and from the discomforts and insecurity and excessive charges of its means of internal communication. Under railway competitions there have been remarkable examples which I might cite of rebounds, such as replacements of returns, under reductions of fares, by more than one-half and even two-thirds, as also of the high profits derived from excursion trains, which will be found to be not solely of passengers, who go for mere pleasure, but largely of persons who avail themselves of the opportunity of the fares being brought within their means to make visits, which they would make more frequently and regularly if the reductions were constant. With this principle for the stimulation of consumption by the reductions of price, there accommodates itself, as a means, another principle of the reduction of the proportion of paid establishment charges by distribution over the subject matters carried. The late Mr. Butler Williams, civil engineer, was so good as to get out for me some illustrative tables which will be found in a paper by him, printed in the *Journal of the Statistical Society* for 1846. Thus, supposing the original cost of construction were £31,000 per mile, and the actual working cost to be one-third of a penny (and it is now stated to have been brought greatly below that), if only 20,000 tons per annum were carried, the fixed charges would amount to 10·08d. per ton, or a total of 10·53d. to pay five per cent., whilst if a million of tons were carried, the fixed charges, including five per cent., would be only ·20d. per ton, or a total of ·65 of a penny per ton, including working expenses. It is a fact established by railway testimony, that whether a railway train carries only fifty or seventy passengers (the actual average), or three hundred, there is no material difference in the actual working expenses per train, whilst the distribution of the establishment charges is a ratio proportioned to the numbers. The effect of the stimulus of cheap fares has, of course, its limits, and if one had a free ticket to go at any speed over all the kingdom, one would not, perhaps, often go from the Land's End to John-o'-Groats. But these limits have not been tried or de-



terminated by railway companies, and it is requisite that they should be tried by an independent authority, and determined in the interests of the public. Instances have occurred where reductions of fares, by two-thirds, are stated to have given the same net returns to the companies, but because the reduced fares did not produce more to them, they discontinued them in their recklessness of the injury they thereby did to the public. Intervention is needed in such cases to secure these great advantages in behalf of the public, and to prevent them being ruthlessly sacrificed to the narrow interests of the railway directors in nothing but profit to themselves. And this intervention may yet be made, if conducted on sound administrative principles, with advantage to the shareholders, with respect to whom it may be averred that the legislature has been in default by the false principles it has maintained, and that it owes to them compensation, or at least security for the future. I am forced to advert to another false principle in legislation. Our first propositions for leasing out the main lines to work as well as to form, have been signally vindicated in France, where the people rejoice that at the end of a term of years (of late grievously prolonged in the undue interests of capitalists), when the leases fall in, they, the public, will have a large revenue from the railways, the application of which they contemplate for paying off their national debt. I shall have, nevertheless, to submit to my colleagues of the French Institute that it would be far better for the development of the productive power and prosperity of that or any other country to reduce the charges on the transport of persons and goods to the lowest cost of proper service, and to charge much of that cost as a land or income tax, rather than to exact any surplus of profit from charges on intercommunication. A toll for the maintenance of a road is only justifiable economically under exceptionable circumstances. The common commercial notion that the test of the value of a road is payment by a toll, is a pernicious fallacy. A toll only proves how many can or will pay it. This evidence viewed by itself, and apart from other facts, shuts out of view the numbers whom the toll deprives of the accommodation of the road. It also shuts out of view the value or money's worth given by the road to others than the toll takers. It is frequently the case that a road does not "pay" by a toll, whilst it pays well, directly and indirectly, in other ways. I have cited, as an illustration, the example of the Waterloo-bridge, near us, treating it as a road. As a commercial speculation it is a total failure and loss, for payment from the tolls, to the shareholders; yet whosoever will look at a map of the southern district, and see the large town which its formation has created, will see that in the increased value of the building land it has been a great success. I was consulted by the late Mr. James Morrison on the economics of this subject, which he adduced before a Committee of the House of Commons, giving instances where the increased value of land, attendant on the formation of railways, would, if capitalised, have paid well for their construction. I might prove, that in the interests of the owners of land and houses, and the leaseholders, occupiers of shops, or farms, a toll is generally as erroneous a means of charging for a public road as it would be to levy tolls on the private roads of a farm or an estate, as a means of paying for them, or of getting a rent. In some instances of branch suburban railways it would be the most economical course to charge the cost of their construction and maintenance, on the rents of houses. But an illustration of the doctrines I have advanced, as to the effect of reductions of rates on consumption, and as to the effect of tolls in impeding traffic is afforded by Waterloo-bridge, and also by the instance of the Southwark-bridge. According to the common commercial notions, no one, except mere beggars, who had occasion to cross the bridge, would hesitate to pay a half-penny, or would abstain, or go round to the free bridges, Blackfriars or West-

minster, to save a toll. Yet, according to the parliamentary returns, the annual average per year, of passengers at a penny, was less than two millions and a-half; and when it was reduced to a halfpenny it was doubled. The averages yearly were, 2,389,059 at a penny, and 5,056,164 at a halfpenny. Since there would be little gain and some trouble to the officers, perhaps, from the increased numbers, the railway policy would be to return to the old fares, even to the hindrance of two millions of persons, and the ignorance of the local representatives would allow this to be done. But I would call attention to the other example of the pernicious effect of a toll as displayed by the result of its entire abolition. The number of foot passengers over the Southwark Bridge, at a penny toll, was for six months 257,616. Experimentally the toll was taken off, when the number of foot passengers for the same period was augmented to 2,359,312. The increase may be said to be nearly tenfold. That is to say, we have it here proved that a toll hindered nine times more than it accommodated. Will any one here doubt the ignorance of vestries which resist charging expenses on rates, which would tend to free communication and interchange by the removal of tolls. Our cousins in America are wont to speak of the almighty dollar as occupying their minds. We might speak of the almighty penny as a subject to occupy our minds, economically and administratively, for the freedom of trade. In Belgium where, although the railways have been conducted on our erroneous views of levying taxes on intercommunication, the fares are greatly below those in England, the Government has brought in a bill to effect a considerable reduction of them, which, as affecting minerals and the metal manufacturer, will give the manufacturers of Liege a considerable advantage over those of Sheffield. In France, as I am informed, where fares have been reduced in particular instances, and for a short time, at the instance of the Government, on extraordinary occasions, the commercial mind there has seen reason not to return to the former rates, though free to do so, and there is a rising agitation for the reduction of the rates in the interests of the freedom of trade. In Ireland, at a meeting of noblemen, gentlemen, landowners, merchants, traders, and others, that was held last week, at Dublin, on this great subject of internal communication, it was in effect determined to apply to the Government and the legislature to return to first principles;—to resume the public control over the railways; to try a considerable reduction of rates and fares; to make every day in Ireland, in fact, as relates to railway fares, an excursion day, and to defray any loss that might accrue before the former net returns are restored, by an addition to the income tax on the revenues of Ireland. It would be an imperial policy, by the reduced fares and increased speeds on this side the channel to bring Ireland nearer by one half, socially as well as commercially, to the influence of the metropolis. Looking at the position of this country, and to the extreme parts of the world from which it obtains the raw material, and returns manufactured products, estimating the vast importance of the cost of transit as an element in competition and price, can we continue to allow intercommunication to be shackled by a protectionism of many millions? To Sir John Burgoyne and various public officers it must be consolatory to perceive that experience is vindicating the great principles which, with myself, they originally contended for. It will now be for merchants, manufacturers, and the public generally who experience the continued and increasing evils of the dereliction from those principles, to try to rescue our chief means of internal communication, for the transit of goods as well as persons, from the trammels imposed by false principles, from which they rescued the postal communication of the empire, and thus set an example of sound administrative reform to all other nations. This may be done in the interests of shareholders as well as of the general public. Long as the time has been during



which I have been compelled to occupy attention, it has yet been too short to enable me to explain the chief financial means available, in my view, to retrieve the errors committed in legislative principle; which means would be, as follows:—Giving the public credit and security for the discharge of the railway debenture debts, by which at public rates from one to two and a-half per cent. might be gained; giving government security for the payment of dividends, by which some third of additional saleable value might be given to the stock without any loss to the public; ensuring the economies, available from unity of management, and contract management; freeing the railways from local and other taxation, which would cease to be chargeable if the railways were restored to their proper status, not as a mere trading speculation, for a private and taxable profit, but as public highways; reducing the expenses of future extensions on the same principle. From these economies, which are only practicable by a public amalgamation, but which might be carried out by a special executive commission, a fund would be derivable, which would be available for equitable division between the shareholders and the public;—to the public more safe, comfortable, and speedy travelling, at lower fares, and reduced rates for the conveyance of goods, as well as other services would be secured; to the shareholders some compensation and security from future loss.

Mr. HILL said Mr. Chadwick, in commenting upon the management of English railways, and in stating that the result was only 3 per cent. dividend to the original shareholders, and comparing that result with the railways of other countries, had dealt unfairly with the matter. The fact was, the difficulties which English railways had to contend with, both in raising capital and in other things, had tended to produce that result. For instance, a certain amount of capital was raised by a company, and found to be insufficient, and thus, through being impeded by legislative restrictions, they were put to all sorts of inconveniences in raising further capital. For instance, when the London and Brighton Railway had a large amount of debentures falling due, they were not permitted to borrow money at a higher rate than 5 per cent.; if they could have borrowed for one or two years at 6 or 6½ per cent., the time would have arrived when the credit of the company would have been so far established that they could probably have raised money at 4 per cent.; but they were permitted to raise a permanent capital at 6 per cent. in the shape of preference stock; and thus the railway was now burdened with a perpetual 6 per cent. stock, which was paid out of the returns before any dividend accrued to the holders of the original shares. If fair means had been allowed to raise the capital, the dividends to the original shareholders would have been considerably increased. The Lancashire and Yorkshire Company had a similar burden of 6 per cent. stock. The London and South-Western had a 7 per cent. stock, though not to a very large amount, and the Chester and Holyhead, now a part of the London and North-Western system, had even an 8 per cent. stock. He therefore submitted, it was most unfair to say that the railways in this country had produced on an average a return of only 3 per cent. on the capital invested. Surely it was unjust to charge that result upon the management of the railways of this country. Moreover, in comparing the foreign railways with the English, it must be borne in mind that in this country enormous sums were paid for land, whilst on the Continent, the government, being interested in effecting speedy communication, expropriated the land, and in that way took off a large burden from the cost of the railways. At the outset of the railway system in this country, great impediments were thrown in the way, through the want of enlightenment on the part of the public. They did not then know what railways would do for them, and so they opposed them. Abroad every facility had been given to railways, and in the fair consideration of this question, regard must be had to the difficulties under which the English railways had laboured.

Mr. SEYMOUR TEULON remarked that while it was quite true, no doubt, that the average return upon the original capital of railways in this country was only 3 per cent., yet, when they found the public funds at 3 per cent., he was astonished that a man of Mr. Chadwick's acuteness of calculation should bring that forward as an instance that the Government would be likely to pay a better dividend on the railways. It was true the ordinary stock paid an average of only 3 per cent., but it was equally true that a large number of railway stocks paid a higher per centage, because Parliament, in its wisdom, had said—after a railway was once made, additional capital should only be raised in a certain way; they might raise additional capital by preference shares; and they had a certain amount of debenture power, and all this tended to keep down the original stock. But there was another cause which contributed to the same result, the heavy charges for rates and taxes imposed on the railways. He believed the quantity of land ordinarily taken for the purposes of a railway was estimated at 10 acres per mile for the line itself. That land might be fairly reckoned at £1 an acre, as agricultural land, throughout the kingdom; but he would add 50 per cent. to that, and take it at 30s. per acre. He had calculated the amount of local rates in a large number of parishes, contributed by railways, and the average was 3s. 6d. in the pound. What was the result? That on a railway 315 miles in length, the poor-rates, church-rates, and highway-rates, without tithes, amounted to £26,000 per annum. In other words, it amounted to above £83 per mile, or £8 per acre paid by the whole of the railway on land which, at the ordinary assessment of other property (putting 50 per cent. on the value for agricultural purposes), would only be 4s. 6d. per acre! Could it therefore be said that the railways were on the same footing as the old turnpike-roads, maintained by tolls? He would go a step further. On the same railway, the rates, taxes, and Government duty, for the year ending July last, amounted to £217 per mile. Thus, without allowing one farthing for the expenses of working that line, more than four weeks' to the receipts of that railway at this period of last year, were absorbed in these charges. Was it to be wondered at then that the original shareholders should receive only a small dividend? Another point alluded to by Mr. Chadwick was wages. What had been the effects of railways upon wages in agricultural parishes? He would tell them what been the effect in his own parish as a landowner. Wages which, some thirty-five years ago, were 9s. per week, were now 15s. in summer, and labour was scarce. Where had the agricultural labourer gone? He was employed upon the railways, attracted there by higher wages than the farmer could give; therefore railways had very materially increased the value of labour. They had placed the labourer in a better position than he was in before. Nevertheless railways had to pay higher rates of wages, and it was only right they should, for they wanted a more intelligent class of men. With regard to the overworking of the servants on railways, he would only say it was not the case in the company with which he was connected.

Dr. PANKHURST remarked that in the paper of Mr. Hawes, in the address of Mr. Galt, and in the supplementary communication of Mr. Chadwick, they had the three views which at present occupied the public attention on this subject. Mr. Chadwick had started by saying that the railway management of this country was defective and unequal to the situation, and that therefore it should be transferred into the hands of the government, that was to say, because it was not such as was approved of by the general public, there were sufficient grounds to destroy the present system. Mr. Chadwick, however, admitted that government administration in many particulars required improvement. It might, therefore, with equal justice be said that in those instances its administration should be abolished. But he asked whether, if the railway system, on that unity of

management which Mr. Chadwick wished for, were in force, and if the economical law which he insisted upon were carried out to the full, whether it would be right to farm out the railways to be worked on commercial principles at all. Mr. Chadwick said they ought to give to the public the power of passing from place to place at the bare cost of transmission; therefore it was not sufficient for him to show that railway management was defective. On the contrary, if it were perfect, still his position would be equally strong; for if the lowest point of reduction of fares were found out, and the largest return produced, still there must be some profit; but that profit, on Mr. Chadwick's system, ought to go into the public purse. Were they prepared, however, to admit that principle—that the great system of railway communication was no longer a subject of mercantile profit? That was the real point at issue; and Mr. Chadwick's view was, in his (Dr. Pankhurst's) opinion, so destructive of the free enterprise of the country, that he was persuaded, on political if not on economical grounds, they would not be disposed to agree with him. Mr. Galt did not go so far as that. He had contended for a uniform rate of charge for fare and conveyance over the whole kingdom. That was possible, even though the commercial system of railway enterprise were maintained. Of course there could not be a low uniform rate without unity of management, and there could hardly be unity of management without government control; and there could not be government control without government ownership. Were they, however, to throw the railway system out of the field of commercial enterprise? Mr. Chadwick had brought forward the experience on the continent, but the continental theory of government was not such as we should be inclined to accept; and the railway system there was a consequence of the system of government. Mr. Chadwick had characterised our railway system as an irresponsible enterprise. It was nothing of the kind, inasmuch as the powers were given upon certain conditions; and if they had any ground of complaint, it was, in the first place, that they had not made sufficient conditions, and next, that they had not sufficiently enforced the conditions which had been made. The railway system was a mixed one; it was partly a monopoly, and partly a subject of enterprise. In the extent to which it was a monopoly, its powers were controlled by the legislature; to the extent to which it was free enterprise, the shareholders might be left to make the most of their position, and to do the work in the most economical way. What, then, was really wanted? Adequate Parliamentary powers of inspection and control; especially with reference to the public safety; for it could not be denied that overworking the people engaged, so as to render them physically disqualified to attend to the duties assigned to them, was an offence against the public. Government control was also wanted in regard to affording proper facilities of transit by Parliamentary and workmen's trains, and as to the amount of the fares that should be levied; and he considered they might then relieve themselves of more than half the objections which had been raised by Mr. Chadwick, and yet leave the splendid monument of our railway system free and unshackled by so vicious a principle as was now sought to be introduced into it.

Mr. W. BOTLEY agreed with the general tenor of Mr. Hawes's paper, for which he considered they were much indebted to that gentleman. At the same time they must all agree that, if the Government as well as engineers had possessed the gift of prescience, it was very probable that the railway system of this country would have been carried out in a different way. But they must now deal with the matter as they found it. He would confine the few remarks he ventured to offer to the monetary effects consequent upon the adoption of the system advocated by Mr. Chadwick, that the Government should be the possessors of the railways. At the end of the year, 1864, the official returns showed an

amount of 425 millions invested in railways, and in the last year a further sum of several millions had been placed in the hands of the Accountant-General in Chancery for public works projected, so that at the end of the present year there would not be a much less sum than 500 millions invested in the railways of this country. Supposing it were possible for the Government to hold that vast amount of capital, what would be the influence upon the monetary state of the country. What would be the consequence if the Government took upon themselves this additional burden of 500 millions? There would be that addition to the national debt of the country, which would so derange its monetary interests as not only to upset all future enterprise, but to sap the foundation of the commerce of the nation. Therefore, in a financial point of view, he considered the scheme would be so detrimental to the enterprise of the country, that no legislature would ever give their sanction to it.

Mr. BRERETON did not gather, either from the paper of Mr. Hawes, or that which had been read this evening in reply to it, that any such intention as the purchase of the railways by the Government ever existed, therefore they were attacking a shadow rather than a substance. Mr. Chadwick had quoted the views of several eminent engineers on the general railway system of this country, but he did not find that any of them advocated that the Government should be the purchasers of the railways. The late Mr. Stephenson was so far a protectionist that he objected to the introduction of new lines into a district that was properly served by existing ones, and he had never suggested that the Canadians should endeavour to improve upon the English system, except by avoiding this mistake, while the remarks of Mr. Bidder only went to the extent of suggesting that means of working the lines should be adopted so as to give larger returns to the shareholders. He did not think Mr. Chadwick had made out a case to show that if such a wish had ever existed, any advantage would result from it. He agreed with the remarks of a previous speaker, that the comparison between the results of continental railways and those in England was not a fair one. The railway system abroad was commenced under the advantages of a considerable amount of experience obtained from this country. He had had some considerable experience in the workings of railways in this country and abroad. In Australia the whole of the railway system had been constructed and worked by the Government, and at the present moment, after an experience of ten years, the Government of Victoria were seeking to relieve themselves of the responsibility of the further working and management of the lines in that colony; and that step had been taken after obtaining ample information as to the working of the continental lines. He thought this was a case in point, showing that governments were not always the best managers of such enterprises.

Mr. ALLPORT said he should not have risen, but that Mr. Chadwick had done him the honour of alluding to his evidence before the Royal Commission on Railways. He scarcely gathered from that gentleman's remarks his object in quoting from that evidence, but if it was done to convey the impression that he favoured the notion of government interference and government management, he would state most distinctly that his evidence was exactly the reverse of that. [Mr. Chadwick said that the evidence referred to went to show that Mr. Allport's attempt to introduce uniformity of rates by private agreement had failed.] What he had stated was that uniformity of rates would, in his judgment—speaking after twenty-seven years' practical experience as a railway manager—be utter destruction to the trade of this country. He said that most advisedly, and after the fullest consideration of the subject; there was no question which, perhaps, engaged the attention of railway managers so much as that of rates. To take his own case—assuming that on the Midland Railway, of which he was the manager, they had a uniform system of rates, what would be the result? The principal traffic on the

Midland line was minerals and coal. Sixteen years ago the entire coal traffic on the line was under a quarter of a million of tons; it was now between six and seven millions. If a uniformity of rates were attempted one of two things must happen—either the rates must be so raised for the long distances that the coal would cease to go to London, the west of England, and all other parts of the country, or, for the shorter distances, the rates would be so low that the railway company would cease to pay interest upon its capital. They were obliged to charge such rates as would develop the resources of the district, and when he spoke of sending coal to London it might be information to some present to state that the entire quantity of coal brought by railway to the London markets amounted to about 2,500,000 tons a year, about 1,400,000 tons of which came from collieries on the Midland Railway, and the average charge for this did not exceed three-eighths of a penny per ton per mile. But it would be utterly impossible for a railway company to conduct its business, if for short distances of thirty to fifty miles they were compelled to charge that low rate. He referred more particularly to coal because it was a very important item in railway traffic, but the same remark applied to a great variety of articles. It was the object of railway managers to develop the trade of each particular district. He might mention silk especially. That trade had been established for many years at Derby, and occasionally as much as from ten to twenty tons of silk were carried by the railway at a time. If uniformity of rates were adopted, and the carriage of silk goods were charged uniformly throughout the country, the result would be that instead of encouraging the development of a particular manufacture, the rates for silk must inevitably be advanced to at least three times the present charges. It was the same with the iron trade. Who would dream of taking a few tons of pig-iron to a small village or foundry at the same rate as would be charged for the enormous trade in pig-iron from the Cleveland, the Staffordshire, or Welsh districts? If uniformity of rates were established it would entirely destroy that large trade. He could in the same way instance other trades. Mr. Chadwick had said a great deal about competition. He (Mr. Allport) thought it had been for the benefit of the country that they had had competition on railways. He was not one who advocated that no new railway should be made because other companies were in possession of a certain district. He did not think there had been many railways made in this country which were not wanted, and the competition which had been brought to bear upon the older railways had had the effect of benefiting the country very largely; but if they put the railways under the charge of the Government, what would become of competition? It would cease entirely. There would be no motive for developing the resources of any district of the country or any particular trade. He would say on behalf of the railway interest, with which he was connected, that there was no power in this country which had tended more to develop its resources and to promote its commercial prosperity than the railways had done. He would mention one fact, which he stated at a meeting in the presence of the Chancellor of the Exchequer. About sixteen years ago, the exports of this country amounted to fifty millions per annum, and there was a great outcry in the public papers that the trade of the country had become inflated, the *simile* used by the *Times* being that of a large balloon that only required some accidental rent to cause the whole thing to collapse. It was argued at the same time that it was impossible to continue an export trade of 50 millions, but in the short period of sixteen years it had amounted to 150 millions. Who talked about inflation now? He saw no reason why it should not be 300 or 400 millions. To what were they indebted for this enormous expansion of the trade of the country? Not to the old roads and canals, but to the railways, and he

maintained that the greatest benefit conferred upon this country had been through the railway interest. Look at the district of South Wales alone; a dozen years ago who ever heard of the South Wales district? There were a few collieries open, and one or two large iron-works, but it was entirely through the railway system that it had now become one of the most important mining districts in the kingdom; and he said fearlessly that that trade had been developed solely by the railways; and he said as fearlessly that, with the railways in the hands of Government, South Wales would have remained very much in the same state as it was a dozen years ago. With regard to the Government purchase of railways, he would ask whether any gentleman present would like to see the national debt increased by 400 or 500 millions. He did not think this would find many advocates in the House of Commons. Then, again, look at the patronage involved in such a scheme. Would any one like to see in the hands of the Government the patronage of between 120,000 and 130,000 *employés*. Was that a desirable thing? They complained now of Government patronage at seaport and other towns; but if they placed the railways in the hands of the Government, there was scarcely a town in the kingdom that would not give (unless they were disfranchised) a very large number of votes to the Government. He thought that of itself was sufficient to prevent the railway system passing into the hands of the Government. A good deal had also been said about the low fares charged on the continental railways; but it was to be borne in mind, as had been already remarked, that in almost every case the land had been given by the Government; and in many instances the works had also been executed by them, and the companies leased the lines, merely finding the permanent way and rolling stock. He believed nearly the whole French railway system had been carried out in that way, and the Government of late years had been increasing the terms of the leases to the companies. Other Governments had been disposing of the railways to private companies; it was, therefore, quite clear to his mind that foreign Governments had not found railway working and management so beneficial or desirable as had been stated. It was perfectly true that turnpike roads were free, and were not subjected to the rates and taxes which were such a great source of expense to the railway companies. He could mention many parishes through which the Midland Railway passed for only a quarter or half a mile, and yet in which the railway paid half of the rates of the parish. This was a very serious expense, and he believed that the same thing had entered into the expenses of almost every railway company in the kingdom. As to wages, there was no doubt (as stated by Mr. Teulon) that railway companies very materially increased the scale of wages throughout the country. Mr. Chadwick laid great stress upon the words "disunity," "disjointed," &c. He seemed to imply that it was impossible to send a passenger, a parcel, or goods beyond the limits of each particular railway. In fact, a stranger to the railway system would suppose, from what Mr. Chadwick had said, that it was impossible to get a parcel booked from London to Aberdeen, or to any distant part of the country, on account of the many conflicting interests which would be brought into play. But what was the fact? It was well known that they could go to any station in London, and book to any place they pleased, not only in England, but in Ireland or Scotland. It was true that they had a choice of route, and for that they had to thank competition. The railways had worked uniformly for the interest of the public, and the public had derived very much greater benefit than the shareholders themselves. He believed the saving to the public in the carriage of goods alone was more than three times the interest paid upon the national debt. He remembered the time when a ton of Manchester goods was charged £8 to London, whereas the highest charge at present was 35s., and large quantities were only charged 20s. If any change were con-

templated in the present charges, he was quite sure that there could not be a much further reduction, either for passengers or for goods. A good deal had been said by Mr. Chadwick about low fares inducing people to travel, but this had not been his experience. He had tried high, low, and medium fares, but he had found that people would not travel unless they had occasion to do so. There was really no analogy between passenger traffic and the post office. He did not think there would be much gained if the fares were reduced to one-half the present scale. He admitted that, in some cases, experiments might be tried, but, as a general rule, he believed that railway companies were able to find out what was the scale of fares which brought the largest number of travellers upon their railways.

Mr. Hawes, in reply, said he felt that there had really been no argument at all brought forward in opposition to the views which he had enunciated. Mr. Brereton in repeating the statement, made in Mr. Galt's speech at the previous discussion, that there was no proposition before the public for the purchase of the railways, had no doubt been led into an error because he had not read Mr. Galt's work. The very first passage in this book—which was a very thick one, and contained everything that could be said upon this question—stated that “in 1844 an Act of Parliament was passed for the purpose of enabling Government to purchase, on certain specified terms, all the railways in the United Kingdom,” that act could not come into operation till 21 years had elapsed, and the 21st year was 1865. His book showed that Government had the power of purchasing the railways; it was published to point out what advantages might be derived if the Government exercised that power. The case he had supposed, therefore, was not an imaginary one, as Mr. Brereton had assumed it to be, but there was the positive fact before them that an act of parliament existed, giving the government the power to enter into a treaty for the purchase of all the railways. Then Mr. Galt, who was supposed to have considerable influence with a member of the administration, had published a book on the matter, and Mr. Chadwick was endeavouring, as he always was, to insist upon the benefits of centralisation, and to show that the government could do much better than any body else, and that they understood the wants of the public better than the public understood them themselves. Both these gentlemen, then, were advocating the handing over the greatest work that had ever been produced in the world to a government whose antecedents showed, as did those of all governments, that whenever they attempted to carry on mercantile transactions they always failed. Had he, or had he not shown this to be the case? Mr. Chadwick, in the paper which he had read, had not touched one of the allegations which he had brought forward to show that Government could not succeed. Mr. Chadwick had not proved that as soon as the penny postage system was announced the Government took Sir Rowland Hill into its employ so as to administer the system. The fact was that for years the Government would not employ him, until he was forced upon them by the public, and it certainly was extraordinary that Mr. Chadwick should have referred to the post office in support of his views. It was also very remarkable that Mr. Chadwick should say what he did about ocean steamers. He said that the mail service could be performed better by Government than by individuals; and he added that if they would only give naval officers the same ships as those employed by individuals they would perform the duty as well. What he (Mr. Hawes) would reply to that was, why did not the Government give such ships to their officers? They had left the providing of the ships to private individuals and to those great companies who had now proved how efficiently such services could be performed. Then he came to the question of the electric telegraph. He had only alluded to this

in his paper to show that Government did not appreciate public wants, that the greatest of all modern inventions was entirely neglected by the Government, and that but for private individuals taking it up in the first instance Government would have left the matter alone till the present time. What said Mr. Chadwick about this? Why, that this service was connected with the railway interest, which was a monopoly, and therefore that public telegraphy became impossible. But did not Mr. Chadwick know that there was a telegraph company running across the country in all directions, quite independently of railway lines, and that abroad telegraph wires were laid irrespective of railways? If the Government had chosen they might have put up telegraph lines altogether independent of the railway interests. Then there was a great anomaly to which he must refer. At the present time the Government carried the letters, which paid a hundred per cent. profit (for the surplus income of the post office was now very nearly two millions), and telegraph companies carried the most important messages and despatches for the Government. Everything of that kind that was of importance, and that involved risk, was given up by the Government to private enterprise, while the government themselves were content to go slowly along on the old system of the post. In all these respects Mr. Chadwick failed in his argument. If it were true, as he stated, that in dockyards and shipbuilding private enterprise failed, why did the Government still avail themselves of private enterprise? Why did they employ Sir Wm. Armstrong to make their guns, or Sir Morton Peto to go to Balaclava? Why did they employ private contractors instead of doing the work themselves. With regard to the rates and fares to be adopted, it appeared that Mr. Chadwick had no fixed ideas upon this point. Was the Government, then, to make experiments to find out what was to be charged? This would only be making the matter worse, because we should be giving up a system of railway management, in which all this was settled, for one which had yet to find out whether they would charge dearer or cheaper than was charged at present. As to the demand for low fares, what more could be wanted than to go from London to Brighton and back—over a hundred miles—for 3s. 6d. As to the foreign lines, Mr. Chadwick had not told them that on the Swiss lines the luggage was charged for independently, and that a man paid almost as much for his portmanteau as he did for himself. Mr. Chadwick had not said anything about the differences between the state of property on the continent and in England. Were they prepared to give up their property in the same way as it was disposed of there? He thought not, and for his own part he would infinitely prefer to pay a higher price for the railways than give up those rights of property which Englishmen so dearly prized. At that late hour, and after the full discussion that had taken place, he would not detain them longer, but he hoped the time was very far distant when such a change as had been talked of would be made. Mr. Chadwick, who was deeply read, and whose memory never failed him, quoted Jeremy Bentham. He told them that he “quoted the words of a great thinker.” There was no doubt that Jeremy Bentham, was a great thinker who lived many years before railways were thought of. But they were living now in days of action, and they wanted more men of action, and not merely thinkers. There were many such among railway directors and managers who would, in the actual business of the world, beat the “great thinkers,” who were so much quoted—even such great men as Jeremy Bentham.

The CHAIRMAN said he would not detain the meeting at that late hour, especially as he had already expressed in that room his opinion on the Government management of railways. He wished, however, to make one remark. His friend, Mr. Chadwick, had said that he had on his side four of the past presidents of the Institution of Civil Engineers. He must say that Mr. Chad-

wick had no right whatever to bring the names of those gentlemen forward as supporters of his views. He knew them all well; two of them were no longer alive to speak for themselves; but he really did not know of anything more likely to bring them out of their graves, if such a thing were possible, than the fact of Mr. Chadwick leading a public meeting to infer that they had ever been advocates for the Government of this country taking the management of the railways. With regard to the other two gentlemen, they were both alive, and would probably read what Mr. Chadwick had said, but he (the Chairman) was certain he might now say for them that he did not know two men further removed from any views such as those advocated by Mr. Chadwick. When they were told that they were advocates of the Government management of railways, he believed they would be very much astonished. For his own part, he differed from Mr. Chadwick's conclusions, though he admitted some of the facts he had adduced. He did not mean to say that the railway system was perfect. Nothing was perfect, but he believed the present system was a better one than they would have had if the railways had been under the control of Government. He believed it would be one of the most destructive measures that had ever been brought forward if the government should even propose to take the railways into their own hands. He felt quite certain, however, that they were fighting a shadow, because, though Mr. Galt might have proposed such a thing, he felt perfectly satisfied that the Government never had such a notion, and never would have. He quite agreed with Dr. Pankhurst, that unless we adopted the constitution of the Continental governments it could never be supposed that our Government would take upon them the management of the railways. He would now only propose a cordial vote of thanks to Mr. Hawes for the very able paper which he had read to the Society some weeks since.

The vote was passed unanimously.

Mr. THOMAS HARRISON, in a letter to Lord Lyttleton, asks—"Why an approximation to our simple and easily worked penny-postage system should not, or could not, be adopted on railways, thus doing away with cumbersome, slow Parliamentary trains, and also with return tickets, excepting so far as that a passenger may pay his fare both ways at one payment, simply making all first-class fares 2d. per mile, and all second-class fares 1d. per mile, any distance and by any train. I believe such an arrangement would work beneficially in every way; it would encourage local traffic to a great extent, many working people only travelling by penny-a-mile trains now, however great their requirements; it would admit of much more uniformity in timing trains for starting, as of course express trains would not be so much required, and when they were necessary, then 3d. and 1½d. per mile might be charged."

### Proceedings of Institutions.

WEST LONDON YOUTHS' INSTITUTE.—The Dean of Chichester presided on Friday, the 2nd February, at the distribution of prizes and certificates gained by the members of this Institute, in the Examinations of the "Metropolitan Association for Promoting the Education of Adults." The Dean was supported by Lieut.-Col. Eyers, Revs. J. P. Gell, H. Brooks, C. E. Donne, H. White, and a number of local clergy and gentry. The Rev. G. B. Macilwain and Mr. H. H. Sales attended as a deputation from the Association. The Dean, after expressing his great interest in the business of the evening, remarked that the word "success" was little understood. In all classes of society there were a large number of persons who would not avail themselves of the advantages placed within their reach, whatever these advantages

were, therefore an institution might be successful although numbers in its locality made no use of it. The Institution was of value, because it afforded the members the advantages of a liberal education. He rejoiced to find that the importance of religious influence was not overlooked. After commending the Examination Scheme he proceeded to deliver the prizes. The Revs. G. Macilwain, H. Brooks, and H. White, then spoke in explanation of the work of the Association to the candidates, and upon Youths' Institutes respectively. The meeting terminated with a vote of thanks to the chairman, moved by the Rev. J. P. Gell.

### Correspondence.

LABOURERS' DWELLINGS.—SIR,—I regret that I was unavoidably absent, as a Member of the Society of Arts, at the discussion of the paper read by Mr. Beggs, as to the Dwellings of the People. If I had been present I should have been enabled, amongst other things, to have corrected his singularly inaccurate statement as to the business of the Conservative Land Society. Mr. Beggs, according to your report, said:—"The Conservative Land Society, according to the last 'Report,' has bought 66 estates, containing 620 acres, and making about 4,842 allotments. The total amount of subscriptions received by that Society is £394,966." Now I make no complaint that Mr. Beggs confined the statistics of our Society to four lines, whilst he devoted some hundreds of lines to the National Land Society and the British Land Company, of both which he is a director; but if he thought proper to cite the Conservative Land Society as an illustration of the extraordinary progress made by building societies, he might just as well have asked for the returns from the office, up to the present date. I know not to what report Mr. Beggs alludes,—it must be a very old one,—and yet I can find no trace of his figures. But I beg to annex our latest returns:—Number of shares of £50 each, issued to date, 23,787; subscribed capital, £1,189,350; cash received since the formation of the Society, £902,561 12s. 11d.; estates purchased, 68; number of acres, 660; number of allotments, 5,661; amount of land sold, £438,505 9s. 5d.; cash advanced to members on security to enable them to purchase land, houses, or to build, £347,713 10s. 1d.—I am, &c., C. L. GRUNEISEN, Secretary to the Conservative Land Society.

Norfolk-street, Strand, Feb. 3, 1866.

### MEETINGS FOR THE ENSUING WEEK.

- MON.....R. Geographical, 8½. Mr. W. Chandless, "Ascent of the River Purus, a tributary of the Amazons."  
British Architects, 8.  
Society of Arts, 8. Cantor Lecture. Mr. Fleeming Jenkin, F.R.S., "On Submarine Telegraphy." (Lecture III.)
- TUES.... Medical and Chirurgical, 8½.  
Civil Engineers, 8. Mr. William Humber, "On the principles to be observed in the designing and laying-out of terminal and other railway stations, repairing shops, engine sheds, &c., with reference to the traffic and the rolling stock."  
Zoological, 8½.  
Syro-Egyptian, 7½.  
Photographic, 8. Annual meeting.  
Ethnological, 8. 1. Mr. Crawford, "On the physical and mental characteristics of the European and Asiatic races of man." 2. Mr. T. Valentine Robin, "Notes and Sketches on the Niger."  
Royal Inst., 3. Professor Tyndall, F.R.S., "On Heat."
- WED..... Society of Arts, 8. Mr. G. R. Burnell, "On the gas supply of Paris."  
Graphic, 8.  
Microscopical, 8. Annual meeting.  
Literary Fund, 3.  
College of Preceptors, 7½. Mr. John Jenkins, "On the Philosophy of Education."
- THURS... Royal, 8½.  
Antiquaries, 8½.  
Linnean, 8. Dr. Welwitsch, "On the probable fossil origin, and the geographical distribution, of gum copal in Angola."

- Chemical, 8.  
 Numismatic, 7.  
 Royal Society Club, 6.  
 Royal Inst., 3. Professor Tyndall, F.R.S., "On Heat."  
 FRI....Philological, 8.  
 Royal Inst., 8. Colonel Sir H. James, F.R.S., "On the Ordnance Survey of Jerusalem."  
 Geological, 1. Annual meeting.  
 R. United Service Inst., 3. Mr. Marshall Hall, "A sketch of the Militia, past and present."  
 SAT.....Royal Inst., 3. Professor Westmacott, R.A., "On Art Education and how works of Art should be viewed."

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

- Par.  
 Numb.  
 430. Convocation—Return.  
 432. Civil List Pensions.  
 434. Thames Conservancy—General Report for 1864.  
 440. Colliers (Ireland)—Return.  
 443. Chamber of London—Accounts.  
 Expenses of Passages—Correspondence.  
*Delivered on 8th July, 1865.*  
 416. Post-office—Return.  
 Ionian Islands—Act containing the Accession of the Sultan to the Treaty concluded March 29, 1864.  
*Delivered on 11th July, 1865.*  
 390. Open Spaces (Metropolis)—Second Report and Evidence.  
*Delivered on 13th July, 1865.*  
 North America (No. 10) (1865)—Further Correspondence respecting the Cessation of the Civil War.  
 Drawbacks on Sugar—Convention between England, Belgium, France, and the Netherlands.  
*Delivered on 14th July, 1865.*  
 Births, Deaths, and Marriages—Twenty-sixth Annual Report.  
*Delivered on 15th July, 1865.*  
 398. Mines—Report from Committee.  
 426. East India (Engineers' Establishments, &c.)  
 436. Dockyard Superintendents—Return.  
 444. East India (Machinery in Jails)—Return.  
 461. Inclosure Commission—Return.  
 453. Friendly Societies (Scotland)—Report by the Registrar.  
 454. Carlisle Cathedral—Return.  
 468. Courts of Justice—Copy of Commission.  
 478. Bankruptcy—Return.  
 480. Militia (Ireland)—Returns.  
 482. Municipal Boroughs (Ireland)—Abstract of Statement.  
 484. Science and Art Department—Statement of the Expenditure.  
 405. East India (British Burmah).

### SESSION 1864.

507. (D.) Poor Rates and Pauperism—Return (D.)  
 552. Numerical List and Index to the Sessional Printed Papers of 1864.  
*Delivered on 17th July, 1865.*  
 Public General Acts—Cap. 61 to 127.  
*Delivered on 2nd August, 1865.*  
 52 (VI.) Trade and Navigation Accounts (30th June, 1865).  
 374. Civil Contingencies Fund—Account.  
 376. Universities and Colleges—Return.

## Patents.

### From Commissioners of Patents Journal, February 2nd.

#### GRANTS OF PROVISIONAL PROTECTION.

- Animal substances, preserving in a fresh condition—138—D.F. Lecocq.  
 Beetroot sugar—225—G. J. Bensen.  
 Blowers—150—J. Stephens.  
 Bodies, lifting tackle for recovering submerged—54—T. W. Roys.  
 Bolts—207—D. Jones and J. Upton.  
 Boots and shoes—2750—G. Haseltine.  
 Bottles, packing—205—J. R. Butchart.  
 Breech-loading rifles, projectiles for—92—T. A. Blakeley and J. Vavasseur.  
 Bricks, &c.—122—C. G. Johnson.  
 Cap and cup frames used in spinning, lubricating the spindles of—160—E. and T. Feather, and J. Luty.  
 Carding engines—201—J. Dearden and E. P. Holden.  
 Coal, getting—94—C. Bartholomew.  
 Coal scuttle—158—J. Bandil.  
 Cocks, taps, and valves—102—W. J. Walsh.  
 Cotton balls—213—N. J. Amies.  
 Electric telegraph apparatus—165—C. and S. A. Varley.  
 Electric telegraph apparatus—237—S. M. Martin and S. A. and F. H. Varley.  
 Fabrics, circular frames for making looped—134—R. A. Brooman.  
 Fabrics, extracting wool from mixed—3378—A. and J. Knowles, and J. Barraclough.

- Fabrics, folding—2550—R. Tonge.  
 Fire and thieves, protecting property from—96—W. A. Rudling.  
 Floors, paper for covering—114—W. R. Lake.  
 Gas—91—P. A. Batchelor and F. Reddall.  
 Gas burners—185—W. Bunger.  
 Grain, drying and cleaning—109—R. T. Sutton.  
 Gumaline, converting refuse of starch, &c., into—3262—W.E. Dobson.  
 Intaglio plates, printing from—239—J. W. Swan.  
 Iron and metallic bedsteads—157—T. Allen.  
 Jiggers, self-acting—129—W. Holdcroft and J. Wood.  
 Lithographic presses—171—F. Cole.  
 Locks—48—F. Tolhausen.  
 Locomotives, feed water heaters for—197—S. F. Allen.  
 Materials, composition for coating—235—J. M. Watt.  
 Mattresses and palliasses—145—S. Dummere.  
 Nails and spikes—146—G. Mellor.  
 Ordnance—46—H. Ames.  
 Ores, crushing and pulverizing—241—J. Jones.  
 Paper, albumenized—66—J. Skinner.  
 Paper pulp—140—C. H. Roekner.  
 Papers, &c., fasteners for binding—104—A. H. Hart.  
 Paper, treating wood for making—35—W. Clark.  
 Paraffin, &c., lamps for burning, without a glass chimney—203—T. Rowatt, jun.  
 Pen-holders, supplying the pen with ink—183—H. Dean and G. A. Wheeler.  
 Plant, obtaining fibre for spinning from a—107—E. and H. Sutherland.  
 Potatoes, preserving—100—F. J. King.  
 Pumping engines—175—J. Shekleton and J. W. Gibson.  
 Railway breaks—156—J. Kennedy and R. Stanley.  
 Railway signals—128—J. Irwin.  
 Rocks, forming tunnels and galleries in—58—H. N. Penrice.  
 Sash fastenings—215—T. Baker.  
 Sewing machines—209—G. B. Woodruff.  
 Ships' compasses—227—E. Hopkins.  
 Ships, propelling—126—J. Hamilton.  
 Shirt studs, &c., fastener for—153—M. Allies.  
 Siphon—217—R. H. Bore.  
 Stamps, damping and affixing adhesive—3335—W. Gill and B. Bird.  
 Steam boilers, preventing incrustation in—3122—J. Toth.  
 Steel and iron—154—F. Preston.  
 Studs and buttons—187—J. McClenahan.  
 Submarine telegraph cables—195—T. Hutton.  
 Surveyors, "plotting" and "computing" scales for—90—H. Dean.  
 Timber, preserving—124—A. Prince.  
 Travelling cranes—211—B. Walker and J. F. A. Pfaff.  
 Tube brushes—139—C. Moriarty.  
 Typographic printing apparatus—243—W. Clark.  
 Umbrellas—179—M. Jackson.  
 Water closets—199—J. Broadfoot.  
 Weaving, looms for—118—W. Gadd and J. Moore.  
 Weaving, pickers used in looms for—3094—R. Edmonson.  
 Weighing machines—108—J. M. Napier.  
 Winding apparatus—141—M. A. Muir and J. McIlwham.

#### INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

- Iron ships, applying copper sheathing to—257—F. L. Roux.  
 Magnesitum, burning—261—G. T. Bousfield.  
 Weaving, looms for—236—G. T. Bousfield.

#### PATENTS SEALED.

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| 2022. J. Gaukroger & J. Dodgeon. | 2128. N. C. Szerelmey.            |
| 2043. A. A. Foubert.             | 2133. P. Lawrence.                |
| 2047. L. J. Crosley.             | 2165. H. Willis and G. Rice.      |
| 2050. W. C. Dodgeon.             | 2223. W. Clark.                   |
| 2051. M. P. W. Boulton.          | 2367. F. Meyer & J. W. Freestone. |
| 2059. J. H. Radcliffe.           | 2643. W. H. G. Jones.             |
| 2064. C. West.                   |                                   |

### From Commissioners of Patents Journal, February 6th.

#### PATENTS SEALED.

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|-----------------------------------------|----------------------------------|
| 2060. G. and A. Harvey, jun.            | 2113. J. Smith and W. Schofield. |
| 2067. B. Russ and E. Gandell.           | 2116. J. H. Johnson.             |
| 2070. L. Schad.                         | 2135. A. and W. Young.           |
| 2071. M. H. Blanchard.                  | 2139. J. L. Naish.               |
| 2073. J. and H. Ingham and J. Broadley. | 2222. I. and W. H. Bailey.       |
| 2074. C. O. Crosby.                     | 2227. W. E. Newton.              |
| 2077. T. Allcock.                       | 2381. A. V. Newton.              |
| 2086. T. E. Stephens.                   | 2465. A. V. Newton.              |
| 2089. J. Tatham and J. Smith.           | 2789. W. Whittle.                |
| 2091. W. Bullough.                      | 2816. J. K. Farnworth.           |
| 2093. W. Betts.                         | 3160. F. Dahis.                  |

#### PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

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|------------------------------------|----------------------------------|
| 307. W. G. Valentin & F. Levick.   | 319. B. Russ.                    |
| 325. W. Betts.                     | 321. J. A. Manning.              |
| 430. J. Gimson.                    | 326. H. Direks and J. H. Pepper. |
| 304. J. Fletcher and H. Bower.     | 328. R. A. Brooman.              |
| 305. A. T. Blakely & J. Vavasseur. | 390. J. Robertson.               |
| 314. G. T. Bousfield.              | 568. S. Williamson.              |

#### PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

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|--------------------|---------------------|
| 276. J. Robertson. | 312. S. D. Davison. |
| 439. J. Bredden.   | 301. S. Tearne.     |